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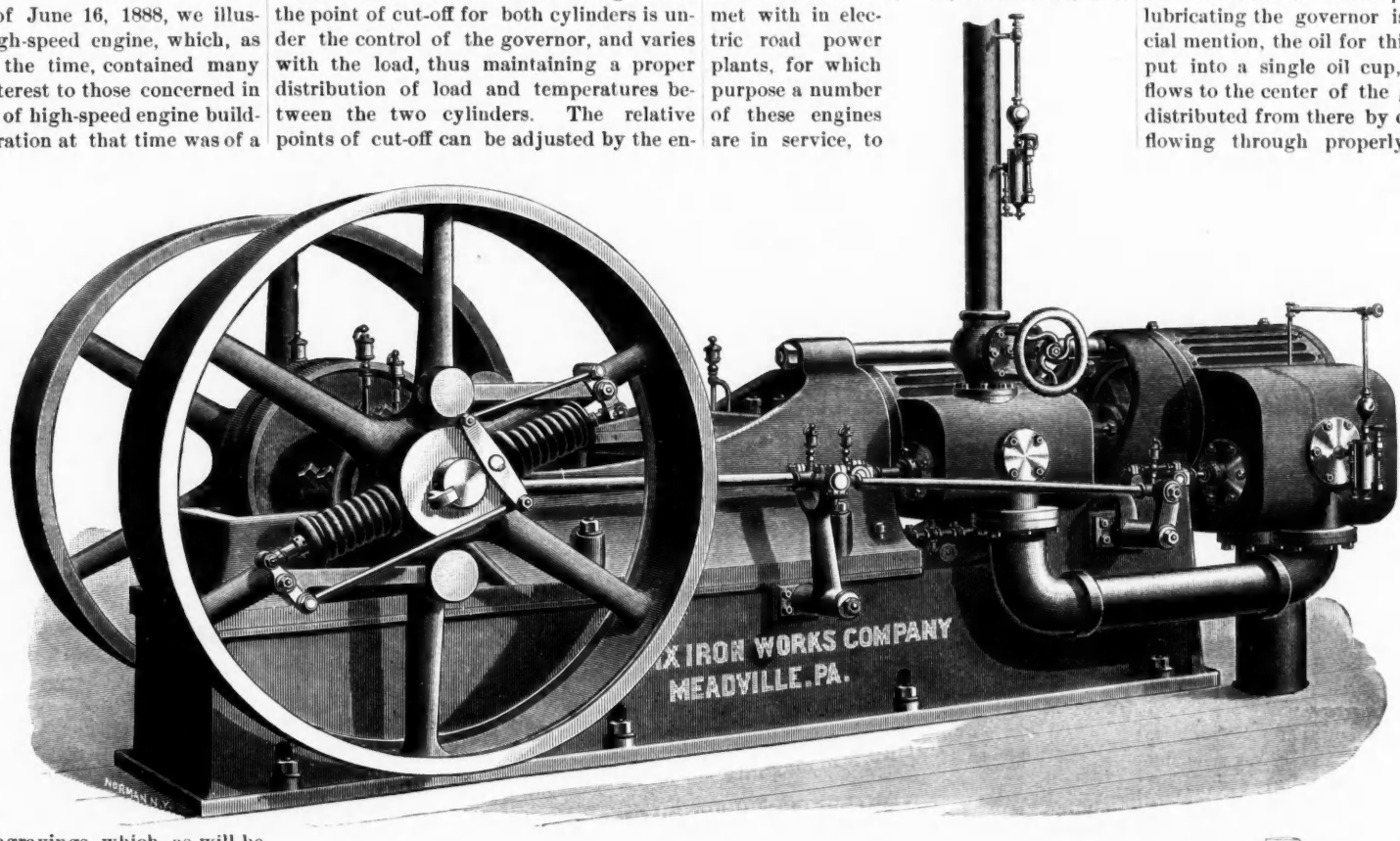
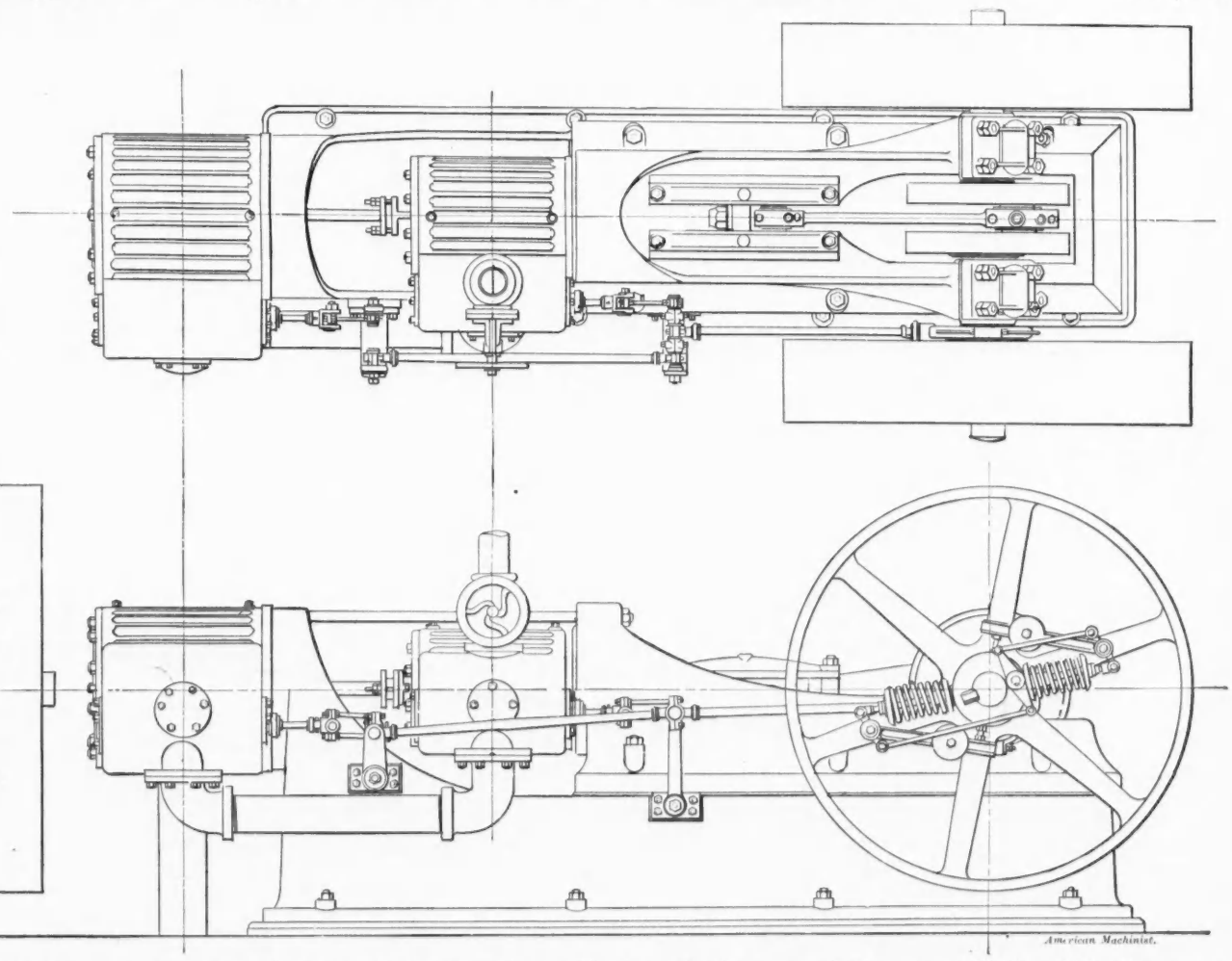
The "Dick & Church" Tandem Compound High-speed Engine.

In our issue of June 16, 1888, we illustrated a new high-speed engine, which, as we indicated at the time, contained many new points of interest to those concerned in the development of high-speed engine building. Our illustration at that time was of a simple engine, that being the only form in which it was then built. Since that time the requirements in the way of generating electric currents for lighting and for power, demanding as they do a very high degree of economy and efficiency, with the closest regulation under extreme variations of load, have led to the development of the engine in the form shown in the accompanying engravings, which, as will be seen, is a two-cylinder compound, both cylinders being overhung, and yet supported from the bed independently of each other, so that they are free to expand and keep in perfect alignment, there being no excessive weight or strain upon either cylinder.



The bed of the engine is made in two parts, the lower or sub-base extending the entire length of the machine, and having a hood at the rear end, to which is attached the low-pressure cylinder. On this sub-base, and bolted to it the same as to a foundation, stands the upper bed-plate on which are the main bearings, guides, and the overhanging high-pressure cylinder. This is perhaps the principal distinctive feature of the engine, and is undoubtedly one of considerable importance, for the reason, besides those mentioned above, that either cylinder is easy of access for repairs without disturbing the other. The rod seen passing over the cylinders ties the two hoods together, making a very rigid construction.

The valve mechanism is so arranged that the point of cut-off for both cylinders is under the control of the governor, and varies with the load, thus maintaining a proper distribution of load and temperatures between the two cylinders. The relative points of cut-off can be adjusted by the engineer to suit varying conditions, but once adjusted they vary together by the action of the governor, thus preventing abnormal variations in receiver pressure. Particular care has been exercised in designing the engine to make all bearings ample for the most severe service, such, for instance, as is met with in electric road power plants, for which purpose a number of these engines are in service, to the entire satisfaction of all concerned.



Particular pains have been taken also with the oiling devices, which are so arranged that every part of the engine can be thoroughly lubricated while the engine is running, and all waste of oil by "throwing off" is avoided. The plan adopted for lubricating the governor is worthy of special mention, the oil for this purpose being put into a single oil cup, from whence it flows to the center of the governor, and is distributed from there by centrifugal force, flowing through properly arranged conduits.

The valves are of the double-piston type, working in casings which are readily removable for repairs and are thoroughly balanced. For illustrations of these, as well as of the governor and other details of construction, we refer to our former issue, the date of which is given above.

A test of one of these engines was recently made at Jamestown, N. Y., which, though unavoidably made under conditions which were very unfavorable to the engine, is sufficient to indicate to those familiar with

such things about what the engine is capable of.

Our limited space prevents our publishing the tests in full, but a synopsis of them may be found interesting.

The particular engine tested is rated nominally at 150 horse power, but the greatest average load obtainable at the time of the test was less than 105 horse-power. The engine working under these conditions developed a horse-power on 17½ pounds of steam per horse-power per hour, and on an actual coal consumption of two pounds per hour, or 1.89 pounds combustible. The coal used was an inferior grade of bituminous slack and nut mixed, and the engine was charged with the entire cost of driving the condenser and boiler feed-pump.

In another test elsewhere under still more unfavorable conditions a result was obtained under 20 pounds of steam per hour per horse-power. In this case two engines were put in to develop 150 horse-power each, or a total of 300 horse-power. Both engines were connected to a jack shaft by friction clutch couplings, and the entire load driven from said shaft. There is one duplex independent air-pump and condenser of 300 horse-power capacity, the expectation being that there would be sufficient load for both engines, and it was desirable to use but one condenser for both. At the time the test was made it was not possible to get a full load for both engines, so that only one side of the plant could be run. The average load was 130 horse-power, and the steam pressure allowed only 90 pounds. This pressure was very much against the manufacturers, though it is unnecessary to explain here why no higher pressure was allowed, but merely to note the fact. This low pressure, together with the large condenser (the steam for which was charged against the single engine instead of both, as designed), as well as the other conditions, were, of course, very unfavorable, but the result will be favorably regarded by those of our readers who are conversant with such matters, and it fully sustains the good reputation of the engine. Both of the tests referred to were made by well-known experts. It is hoped soon to have a test made under conditions which will properly demonstrate what this engine is capable of doing.

These engines are built in various sizes, ranging from 9½" and 17" cylinders, 12" stroke, to 13" and 23" cylinders, 18" stroke, 80 to 300 horse-power, according to speed and boiler pressure, by the Phœnix Iron Works, Meadville, Pa.

Work on Government Vessels.

Henry T. Scott, of the Union Iron Works of San Francisco, is reported as saying:

"We are getting the machinery of the Monterey into place as rapidly as possible. The boilers are set, and one engine is in position, and the other two are now on the wharf ready to be put in position. Everything will be ready for the trial trip in October, and, if we are not detained by failure of the government to send armor, the vessel will be completed and ready to be turned over long before the date provided for in the contract. It is time we received armor plating, and if it does not come along very soon the work will have to be delayed to await its arrival. Cruiser No. 6 is getting along well, but it is impossible to state how soon she will be launched."

The Ironmonger, London, states: Mr. Ernest Trubshaw, J. P., and Mr. J. S. Tregoning, J. P., Llanelly, tin-plate manufacturers, are expected to leave Wales shortly, on a visit to the United States. Their return will be awaited with considerable interest, as they will doubless have something to say on the rumors about laying down of plant in America for the manufacture of tin-plates.

Good Work and Good Ways of Doing It.

BY A MECHANIC.

In order to decide the best way to proceed in doing a given piece of work, a large amount of study is often required. When we say that such a man is a good machinist, one who is capable of doing good work by the most modern methods, we should not try to convey the impression that that man can decide the very best way to proceed in any given case at a moment's notice.

Years of experience, together with careful study of all occurrences during these years of experience, will help the right kind of a man to correctly weigh all the points in a case, and so pass a fairly correct opinion, but this is never an instantaneous process, nor is it always dead sure.

I remember of reading about the discussions of the mechanical engineers at the Providence meeting, when the premium plan of paying for labor was being discussed. I have forgotten the names, but what I wish to call attention to is this: One gentleman told of a boy who invented some little kink by which he was able to turn out more work than without it. Then another man objected to such evidence, saying that there must have been something the matter with this foreman, for he did not show this boy this kink on the start; that what they wanted to get at is, "What is a day's work?"

This conveyed the impression to me that this man's experience in mechanical matters was very limited, or he would not be talking about the *how* to do work as a standard thing.

This inventing little kinks to fit the work by the workmen themselves is an every-day occurrence. Each little kink is a distinct invention, just as much so as the telegraph or telephone is; but, of course, of less value, for the value of an invention depends upon the extent of its application. It is just as unreasonable to reflect on the ability of any foreman for not showing a boy, or man, all the kinks that will apply to the work in hand, as it would be to reflect upon the abilities of all the smart men of the ages gone by for not inventing the telegraph. If any one wants to get at "What is a day's work?" I think he had better make preparations for a long hunt. Better instruct his children to instruct theirs, and so on to continue the search, for it *will be* a long one. A company can be organized to-day to go into the manufacture of a certain thing, and employ the best mechanics to be had, with plenty of capital, carry out these good mechanics' ideas, and so succeed in bringing such line of manufacture ahead of anything else in existence.

But who can say that if such a factory could be brought to light, in working order, one hundred years from now, that it would not be a laughing stock for the mechanics of that time?

By this I want to call attention to the fact that the man who is quite sure that he knows the very best way to proceed in any case, at a moment's notice, is only a case of "Where ignorance is bliss"—you know the rest. I find it a good plan, when starting to do a good piece of work, to first find out if possible just what the work is for, or, if this is impossible, to find what degree of accuracy is needed in different parts of the work. No person can work with intelligence without knowing this. Next in order comes the means at hand to work with; we have to plan to fit our tools.

I have a few practical examples to show. In Fig. 1 I undertake to show how a piece was bored for a jig to the accuracy required. *A* shows the face of piece to be bored, and *B B B* the three holes that were required to be spaced equally, and all on a line parallel with the edge of piece, within a limit of about .002", or, if less, all the better. We knew just what this piece was for, so the first thing was done.

We could locate three buttons on the face of the work, and then true them in the lathe by swinging the piece over; but that would not do, for there was not a lathe to be had that would swing the piece when boring the end holes, and besides this we do not like this way of working when there are better ways within reach. There is a chance for error in locating each button, and there is a chance for another in truing each one in the lathe; and besides these chances for error, there is a good chance to waste a large amount of time and patience by such a method.

We could bolt the work to the lathe carriage, but this would be too inconvenient. We could do the job on a good upright drill, but we did not have such a tool. We could do the job on a good boring machine, but this we did not have. The next thing we think of is the milling machine, which we have. We drill and counterbore the holes on the old drill press to within $\frac{1}{16}$" of size.

We then clamp the work to a knee on milling machine platen, as shown in Fig. 1, and bore the central hole first, with the single-pointed cutter *D*, first just truing the hole, then measuring through the sides with calipers to find which way the knee of milling machine needs moving to bring the hole in the center of piece; then after we have found the center we bore the hole to size. Before starting the boring we had trued a spot at *E* on the boring arbor, and turned it to the size (1¼") in its place, by holding a lathe tool in the milling machine vise, and turning it as in the lathe. After boring the central hole we fitted to it the bushing, or collar *F* (shown in section *A B*), to just a snug push fit. We then arranged the work as shown in Fig. 1, bolted the collar *F* to the knee through the hole in work, with the work resting on the edge of platen as shown, then set the distance from hub *F* to end of boring arbor *E* with the "end measure" *G*, by drawing the milling machine platen back.

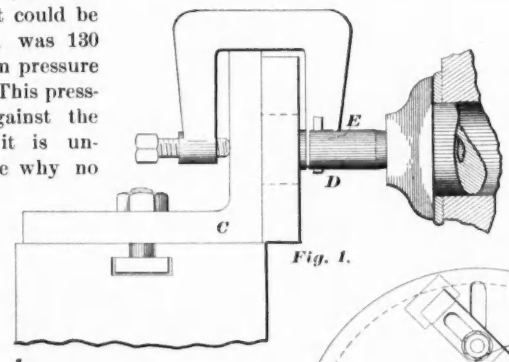


Fig. 1.

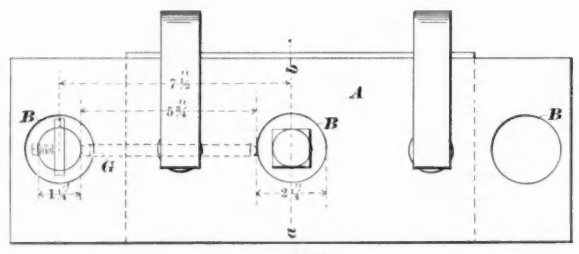


Fig. 1.

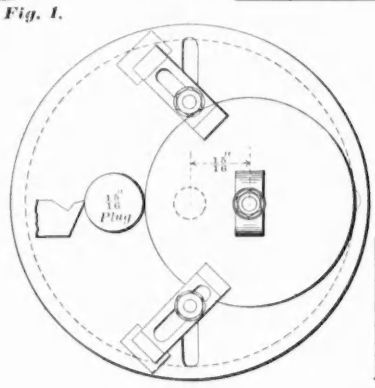
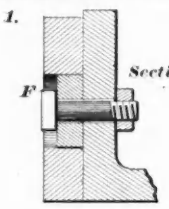


Fig. 2.



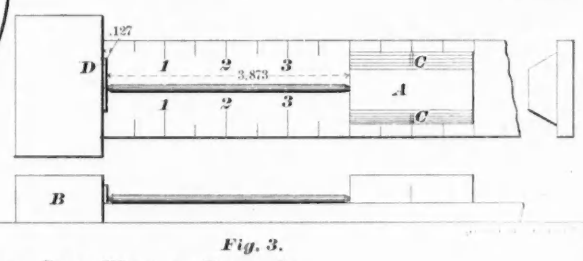


Fig. 3.

GOOD WORK AND GOOD WAYS OF DOING IT.

When everything was right we made the platen fast and bored the first end hole. Then, leaving things set as they were, we turned the piece "end for end" and bored the other hole, and so easily got what we wanted.

In the AMERICAN MACHINIST of July 30 Mr. Webster gives a very interesting account of a nice piece of work being done. I think it would have been still more interesting had he told *how* the work was done. It makes a great difference about the hardness of doing it. I do not mean to say that such work would not call for great skill, however it was done, but I do say that such fineness would be decidedly hard to get by some ways of working.

In Fig. 2 I show a way that I have used for spacing two holes in a disk accurately.

As in the case shown, I want two holes $1\frac{5}{16}$" apart.

I bore the central hole first on the face plate as shown, having first made sure that the face plate is true and flat, and having the back side of disk squared true.

After boring the central hole, without changing the position of work I true the outside of disk.

I then set the work off center till the $1\frac{5}{16}$" plug will just fit the throw as shown, and we could quite easily by this way get the space within .0005" of what is required.

In most modern machine shops a great many "end measures" are used. For short "end measures" many places have either micrometers or verniers, but for long ones in most places I think a steel scale is the only thing available. I show in Fig. 3 a little block (*A*) which is a convenience in "taking off" measurements from a scale.

I would have the scale rest on a flat surface, and have the square block *B* at an end, as shown, so as to fit end measure between block *A* and block *B*, as shown. I make block *A* just two inches long, with square ends, then stand it on end on a surface plate, and with a scratch block draw the two lines on each side (*C C*) by changing the piece "end for end," and with the pointer of scratch block set, I plan to make the space between lines about the width of a line on the scale.

When we have an "end measure" to make as shown (3.873") to some dimension not on the scale, I use a thin piece as shown at *D*, which I can make to the required dimension by the use of a small micrometer caliper. Sometimes I use paper of the desired thickness.

Improvements of Wheeling & Lake Erie.

The management of the Wheeling & Lake Erie Railway have just announced the extent of the progress made in the plans for developing the business of the company. The coal company controlled by the railroad company has put up 181 houses for its miners, and ninety more will be completed this season. The number of miners is being rapidly increased with the opening of new mines, and the output of coal will be raised to 100,000 tons per month, against 50,404 tons in June, and 21,695 tons in January. Extensions have been made by the railroad company to reach new industries, and improvements on Lake Erie have been important. The company has increased its equipment by 22 locomotives, 200 box cars, 1,000 coal cars, and 6 passenger coaches. Work on new machine shops at Toledo will begin within a few weeks.—*New York Tribune.*

Parallel Motions.

BY PROF. A. MACLAY, GLASGOW, SCOTLAND.

SECOND PAPER.

(3)—EXAMPLES FOR DRAWING.

Example 1.—*Draw the linkage shown in Fig.* 1 (*see our issue of Sept.* 17*th*) *in heavy lines to twice or three times the size. Suppose the point A to be fixed, and assume that the point K at the other end of the transversal A K is constrained to move in the straight line* $K^1 K_1$, *then show that the points E, F and G —the intersections of the transversal A K with the cross links B H, C I, D J respectively—will also move in straight lines, and with ranges of motion proportional to their distances from the fixed point A.*

The construction simply amounts to assuming a series of positions of the point K, and drawing the corresponding positions of the various links for each new position of K. Thus, for example, having drawn the linkage in the position shown (making $B D$ say $2\frac{1}{2}''$ or $3''$ long, and the remainder in somewhat the same proportion to the figure) suppose K^1 to be one of these assumed positions of K. Join $K^1 A$. With radius $A D$ and center A draw an arc of a circle towards K^1, and with radius $K J$ from center K^1 draw an arc towards A. Take a strip of paper cut to a straight edge, and on it mark three points, D, G and J, at the same distances apart as D, G and J on link $D J$, then adjust the position of the strip until simultaneously D lies on the arc drawn from A with radius $A D$, G on the straight line $A K^1$, and J on the arc drawn from center K^1, with radius $K J$. Then in this way having determined the new positions D^1, G^1 and J^1 of the points D, G and J, draw $A D^1$ and $K^1 J^1$ produced. On these lines mark off C^1, B^1, I^1, H^1, and join $B^1 H^1$, $C^1 I^1$. $K^1 H^1$ will be found to be parallel to $A D^1$ and $C^1 I^1$, $B^1 H^1$ parallel to $D^1 J^1$, and the paths $E^1 E$, $F^1 F$ and $G^1 G$ will be found to be parallel to $K^1 K$, and the ranges of motion or strokes will be found to be respectively proportional to the lengths $A B$, $A C$, $A D$ and $A L$. Several other positions of the point K should be assumed, and the relative positions of E, F and G found in the same manner.

Example 2.—*Draw the pantograph shown in Fig.* 2 (*see our issue of Sept.* 17*th*) *to three or four times the scale. Suppose point G to be fixed, and that B is made to trace out some curved outline. Show the path traced out by a pencil point at F on link a.*

Having drawn the linkage in the position shown (making $A B$ say $4''$ long) assume any second position B_1 of the point B on the given curve $\beta\ \beta$. With G as center radii $G C$ and $G D$, draw arcs $\gamma\ \gamma$ and $\delta\ \delta$ respectively. Next with B_1 as center radius $B C$, intersect are $\gamma\ \gamma$ at C_1. Then through C_1 draw $G D_1$, and parallel to it through B_1 draw $B_1 E_1$, making $G D_1 = G D$, and $B_1 E_1 = B E$. Also through C_1 draw $B_1 H_1$, and parallel to it through D_1 draw $D_1 F_1$, making $B_1 H_1 = B H$, and $D_1 F_1 = D F$. Then F_1 is a second point on the required curve $f f$. In the same way as many other points can be obtained as are required for tracing out the enlarged copy of the curve $\beta\ \beta$.

Example 3.—*Place a parallelogram upon an ordinary quadric crank. Fix one link and trace the path of any two intersections of a transversal with the links of the parallelogram.*

Let $A B C E$ (Fig. 3) represent the given parallelogram carried by the quadric crank $A B C D$, having $A D$ as its fixed link. Draw any transversal $A X$ intersecting link $B C$ at the point P, and link $E C$ produced at the point Q. Draw to a larger scale of the figure (making $A D$ say $5''$ or $6''$ long), and show that the path of Q reproduces the path of P in the proportion $A Q$ to $A P$.

Begin by drawing circular arcs $b\ b$, $c\ c$ and $e\ e$, representing the paths of the centers of the joints B, C and E. Next determine the limits of the range of motion of these three centers. Firstly for that of B. With center D, radius $D C + C B$, describe arcs cutting circle $b\ b$ at B^1 and B_1. These represent the extreme positions of the joint B to the left, top and bottom. Similarly for the range of motion of link $A E$. With center D, radius $D C + C E$, cut the circle $e\ e$ at the points E^1 and E_1. These mark the extreme positions of the joint E to the left, above and below E. For the range of movement of $D C$ proceed in the same manner. With center A, radius $A B + B C$, intersect circle $c\ c$ at C^1 and C_1. Then $D C^1$ and $D C_1$ represent the extreme positions of link $D C$ to the right.

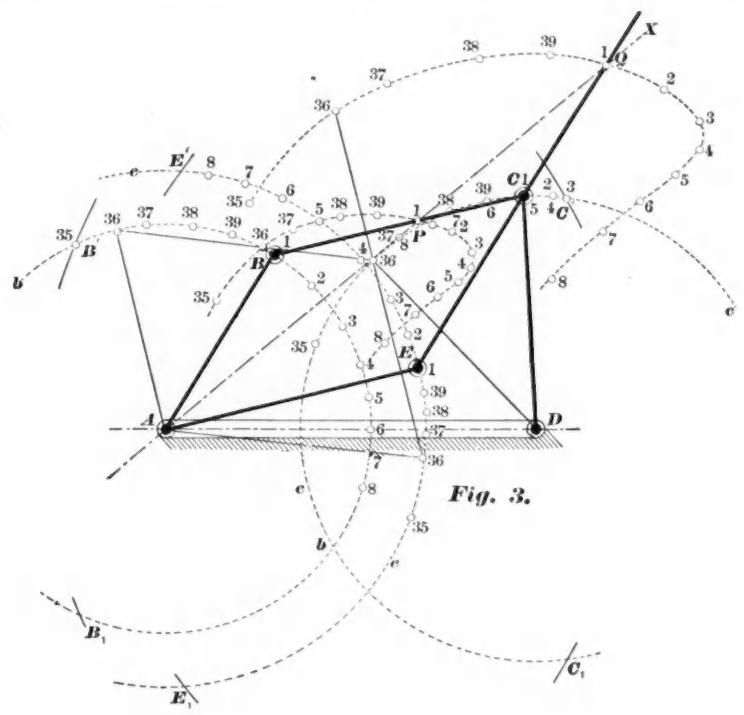


Fig. 3.

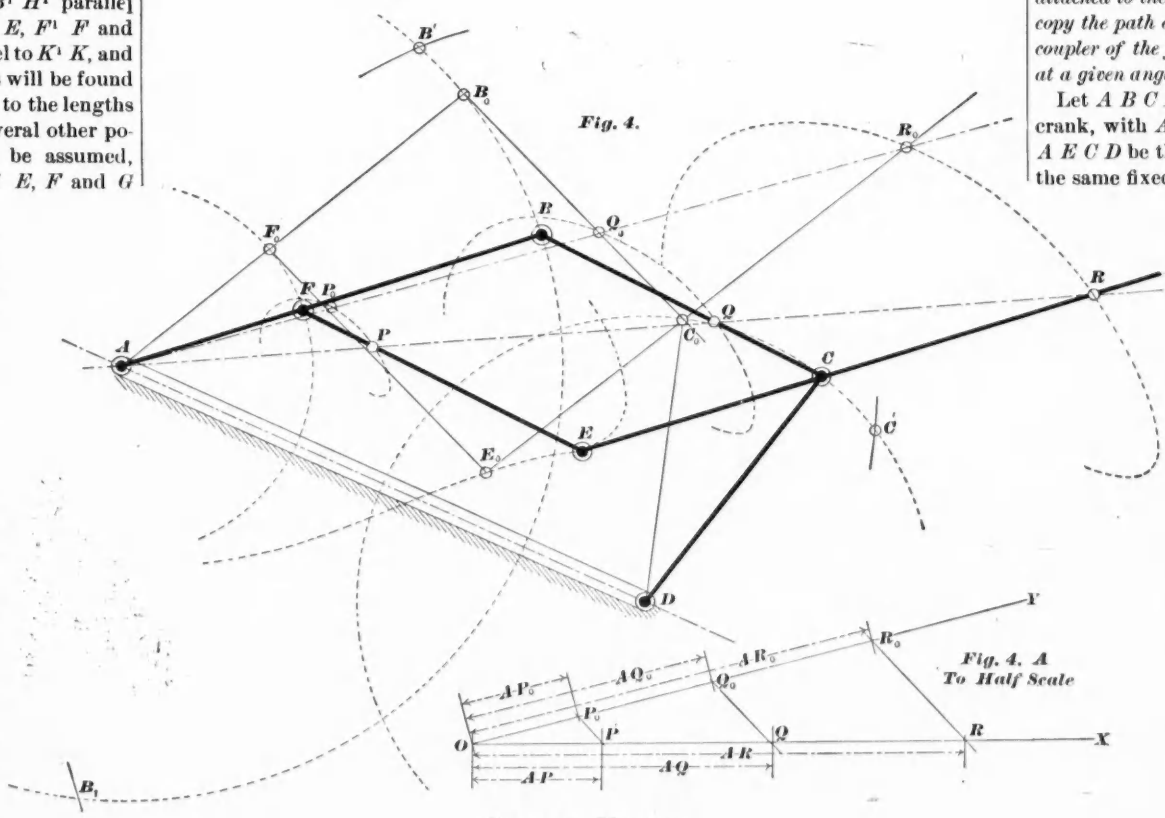


Fig. 4.

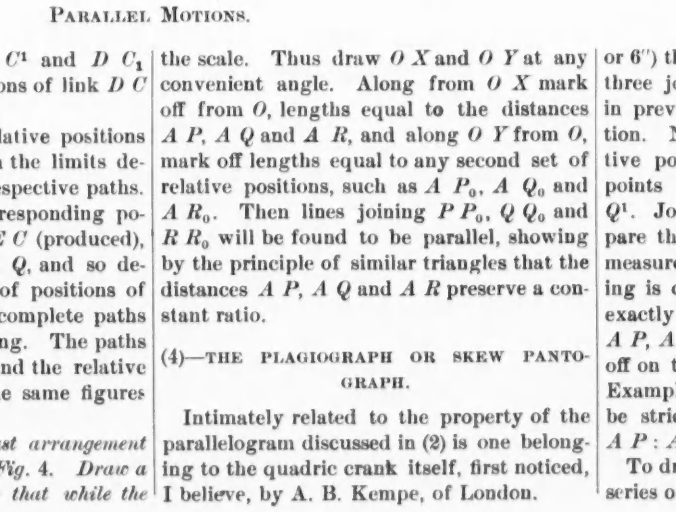


Fig. 4. A
To Half Scale

PARALLEL MOTIONS.

Next assume a series of relative positions of joints B, C and E between the limits determined as above, on their respective paths. Then having drawn the corresponding positions of the links $B C$ and $E C$ (produced), mark off the points P and Q, and so determine a sufficient number of positions of each to be able to draw the complete paths by curve sticks or by sketching. The paths are partly shown in Fig. 3, and the relative points are numbered with the same figures throughout.

Example 4.—*Modify the last arrangement as shown at A B C D E F, Fig.* 4. *Draw a transversal A P Q R. Show that while the linkage is turned about centers A and D, the points P, Q and R always remain on a straight line passing through A, and at a constant distance ratio from it.* (Make $A D$ about $6''$ long.)

Proceed as in the last example. First draw the circular paths of the centers of the joints F, B and C. Then determine the limits of their ranges of motion. Next assume a series of positions of one of those joints, and find the relative positions of all the links in each case. Lastly mark off successive positions of P, Q and R. Test the first condition by drawing straight lines through these positions, and the second condition by marking off distances representing pairs of consecutive distances of each point from A, as shown in Fig. 4 A, to half the scale. Thus draw $O X$ and $O Y$ at any convenient angle. Along from $O X$ mark off from O, lengths equal to the distances $A P$, $A Q$ and $A R$, and along $O Y$ from O, mark off lengths equal to any second set of relative positions, such as $A P_0$, $A Q_0$ and $A R_0$. Then lines joining $P P_0$, $Q Q_0$ and $R R_0$ will be found to be parallel, showing by the principle of similar triangles that the distances $A P$, $A Q$ and $A R$ preserve a constant ratio.

(4)—THE PLAGIOGRAPH OR SKEW PANTOGRAPH.

Intimately related to the property of the parallelogram discussed in (2) is one belonging to the quadric crank itself, first noticed, I believe, by A. B. Kempe, of London.

If in any given quadric crank $A B C D$ (Fig. 3) we make the crank $A B$ and the coupler $B C$ exchange places, then it will be found that for any point P on the coupler $B C$ of the first arrangement, a corresponding point Q can be obtained on the coupler $E C$ of the second, which will copy its path in the proportion of their respective distances from the fixed point A.

Following this up, Professor Sylvester, of London, pointed out that the property is not confined to points on the axis of the coupler of each quadric crank, but that for any point P belonging to the coupler of the one, a point Q can be found belonging to the coupler of the other, which will not only reproduce its path to any required scale, but will turn it through any required angle. Thus, referring to Fig. 5, let P be any point rigidly connected to the coupler $B C$ of the quadric crank $A B C D$, then a point Q can be found, which, if rigidly connected to the coupler of the quadric crank $A E C D$, will reproduce the path of P at a constant distance ratio $A Q$ to $A P$, and at a constant angle $P A Q$. If now the link $C D$ be dispensed with, the path of P may be made anything we like, but the relationship between it and that of Q is not altered in any way. It will be evident, then, that the remaining links present us with the pantograph in a new form, which has been called by its inventor the *plagiograph or skew pantograph*. It represents the general form of a pantographic apparatus, of which the ordinary pantograph may be looked upon as a particular case, for it will not only copy figures like the ordinary pantograph, but it will turn them through any required angle.

Example 5.—*Draw any given quadric crank. Assume one of its links to be fixed, and on the same fixed link and to the same side of it let there be a second quadric crank, in which the coupler and one of the cranks of the first have been made to exchange places. Find a point attached to the coupler of the second, which will copy the path of a given point attached to the coupler of the first in a given proportion, and at a given angle.*

Let $A B C D$, Fig. 5, be the given quadric crank, with $A D$ as its fixed link, and let $A E C D$ be the second arrangement, having the same fixed link $A D$ and one crank $C D$ in common with the first. Let the crank $A E$ and the coupler $E C$ of the second arrangement be made equal in lengths to the coupler $B C$ and the crank $A B$ respectively of the first. Draw to twice or three times the scale of the figure. Assume any point P as part of the link $B C$, but not on its axis. Join $P B$ and $P C$. At E set off a line $E Q$ so that angle $C E Q$ = angle $C B P$, and through C draw a line $C Q$ such that angle $C Q E$ = angle $B P C$. Then show that the point Q, as belonging to the link $E C$, will reproduce the path of the assumed point P belonging to the link $B C$ in the proportion $A Q$ to $A P$, and at the constant angle $Q A P$.

Having drawn the mechanism in the position shown in Fig. 5 (making $A D$ say $5''$ or $6''$) then describe the circular paths of the three joints B, C and E, and determine, as in previous examples, their ranges of motion. Next assume any second set of relative positions of B, C and E, and of the points P and Q, as at B^1, C^1, E^1, P^1 and Q^1. Join $A P$, $A P^1$, $A Q$ and $A Q^1$. Compare the angles $P A Q$ and $P^1 A Q^1$. By measurement it will be found, if the drawing is correctly done, that these angles are exactly equal. Next compare the lengths $A P$, $A Q$ and $A P^1$, $A Q^1$. By laying them off on two lines $O X$, $O Y$, as explained in Example 4, Fig. 4 A, $P P^1$ will be found to be strictly parallel to $Q Q^1$, showing that $A P : A Q :: A P^1 : A Q^1$.

To draw the paths of P and Q, assume a series of relative positions of the centers of

joints B, C and E. Determine for each set the relative positions of P and Q, and having obtained a sufficient number of points trace the path of each, as partly shown in Fig. 5.

The geometrical proof of the above may be stated as follows. By construction the triangle $Q\ C\ E$ is similar to the triangle $P\ B\ C$, the angles at E, C and Q having been made equal to the angles at B, P and C respectively. Therefore

$$\frac{P\ B}{B\ C} = \frac{C\ E}{E\ Q} \text{ or } \frac{P\ B}{C\ E} = \frac{B\ C}{E\ Q}, \text{ hence}$$

$$\frac{P\ B}{B\ A} = \frac{A\ E}{E\ Q}.$$

Again $<A\ B\ C = <A\ E\ C$. But by construction $<P\ B\ C = <C\ E\ Q$ $\therefore$ $<A\ B\ P = <A\ E\ Q$. It follows that the two triangles $A\ B\ P$ and $A\ E\ Q$ are similar in every respect.

Therefore $\frac{A\ P}{A\ Q} = \frac{P\ B}{A\ E}$, *i. e.*, $\frac{A\ P}{A\ Q}$ is a constant ratio.

In a similar manner it can be shown that the angle $P\ A\ Q$ is a constant angle. In Fig. 5, the path of C is a circle, but it is evident that the above principles are independent of the path of C. Therefore if P be guided over the boundary lines of any figure, Q will reproduce it on a scale depending only upon the ratio $\frac{A\ Q}{A\ P}$, and in a position depending only upon the angle $P\ A\ Q$.

Shaft Coupling.

Some time since, at a meeting of the Engineers' Club, of Philadelphia, Mr. Wilfred Lewis described a new shaft coupling which was designed for a special purpose, and which is illustrated by the accompanying engravings. We quote from Mr. Lewis' paper as follows:

"In its present form the coupling has passed through an experimental existence in the hands of Wm. Sellers & Co., incorporated, and is thought to have sufficient merit to be worthy of the patent which was granted for it a few months ago. It is not, therefore, strictly speaking, a brand new thing, but it occurred to me that some account of the failures that led to its invention, together with the tests to which the joint has recently been subjected, might be of interest to the club. The need of such a coupling came to my attention about six years ago, while working up the design for a traveling crane to be driven by a square shaft with a sliding sleeve. Quite a number of methods of accomplishing the desired result suggested themselves, and of these I may mention the welded joint, the scarfed joint, the double-scarfed joint, and a notched joint with a central pin holding the notched ends of two shafts together.

"The welded joint, when well made on wrought-iron or soft steel shafts, is undoubtedly superior to any other in strength, stiffness and durability, but it is not a convenient joint to put together or take apart in a line of shafting supported on tumbler bearings, often 30 or 40 feet high. In making such a joint the alignment must be carefully preserved, and the length of the shaft, when finished, must be reasonably accurate, on account of spacing the tumbler bearings. Electric welding might be employed to advantage on small shafts, but it does not seem practicable as yet to weld shafts from 2½ to 3½ inches square in place by that method.

"One objection to the welded joint may be raised on account of the deterioration suffered in some grades of steel by unequal heating, but the most serious objection to it lies in the difficulties which attend the operation of welding in place. The scarfed joint was considered, and rejected on account of its inherent weakness, all the strains passing through it being transmitted by the uniting rivets. The double-scarfed joint had decided advantages over the single scarf in the transmission of torsional strain, and for bending strain the rivets acted in double instead of single shear, but still the rivets were subject to strain in every direction, and were consequently liable to work loose. The double-scarfed joint was, therefore, rejected also as impracticable. To avoid the difficulty of constructing a rigid joint capable of sustaining transverse as well as torsional strain, a loose joint was contrived by simply notching the ends of two shafts, and uniting them by a pin in the axis of the shaft held by cross-pins or rivets at the ends.

This joint was theoretically much stronger than the scarfed joints for torsion, and being comparatively flexible, it was expected that the necessity for very accurate alignment would be thereby avoided. But this expectation was not realized, and after a few months in service the wear on the driving surfaces began to be apparent. To reduce this tendency to wear, care was taken to perfect the alignment, and in subsequent joints the notches were cut deeper. It was evident, however, that something better was needed, a loose joint being subject to wear from imperfect alignment, and all rigid joints, hitherto considered, being laterally weak.

The coupling now before you was designed to remedy all the difficulties and defects which I have just pointed out. It may be described as a combination of interlocking grooves and tongues united by rivets. The shaft is grooved on planes passing through its corners, the space between the bottoms of the grooves forming a strong web, which is slotted from the end for half its length. When put together the tongues on one shaft are drawn up by rivets passing through the web on the other shaft. The rivets thus bring the driving surfaces into close contact, and the joint is not liable to rub when out of alignment, on account of its length and lateral stiffness. Furthermore, there can be no strain on the rivets other than the initial strain under which they are set, and they are, therefore, not liable to work loose. To take the joint apart it is simply necessary to chip off the heads of the rivets and drive them out. These couplings are all fitted up to gauges, and the rivet holes are drilled after the shafts are put together. In regard to strength, stiffness and durability, the three requisites for a good coupling, the problem appears to be satisfactorily solved.

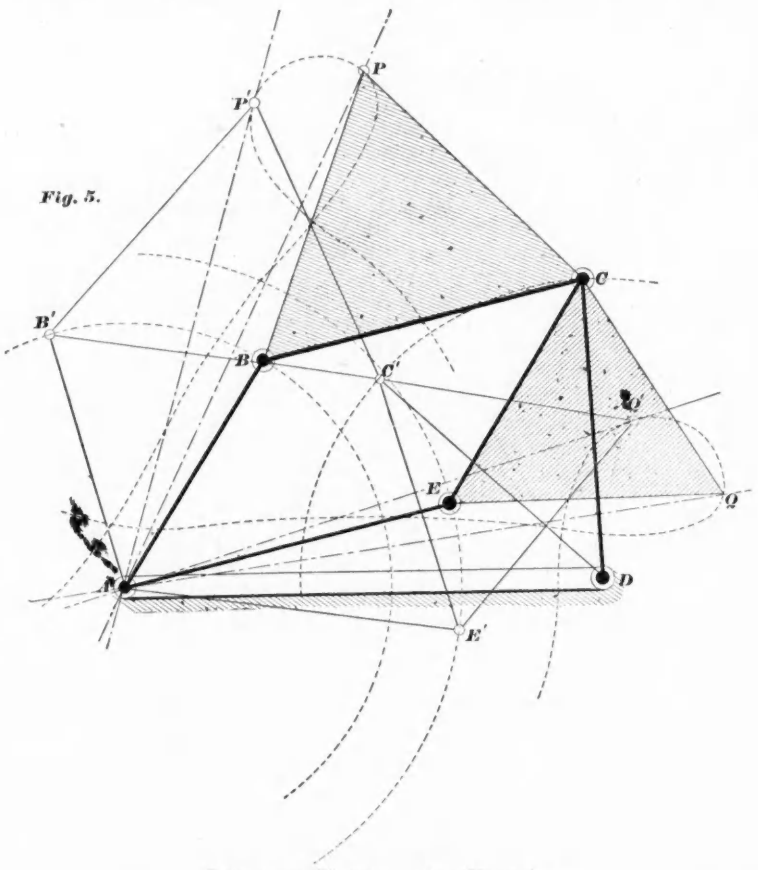
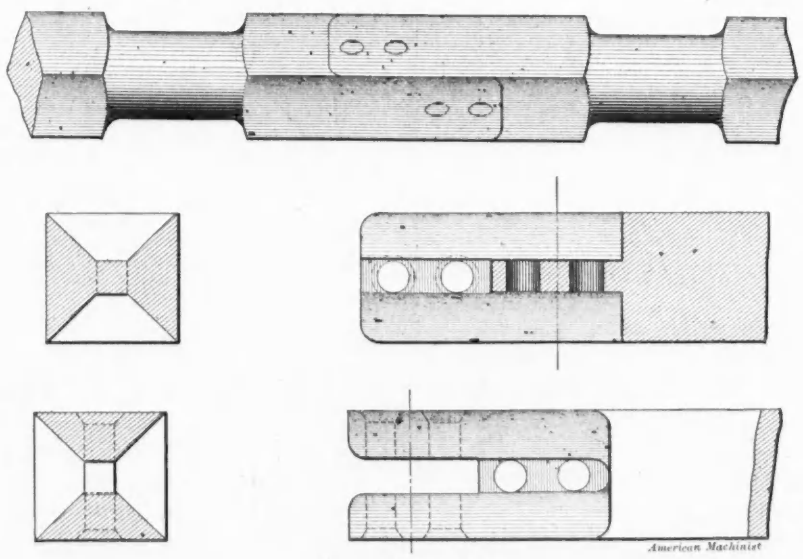


Fig. 5.

PARALLEL MOTION.—SEE PAGE 3.

To ascertain the torsional and transverse strength of the joint, the samples on exhibition have been tested to destruction, or nearly so, in the following manner: A short piece of coupled shafting, 2½ inches square, was fastened at one end, while the other end was supported so as to be twisted by a weighted lever. A load of 1,000 pounds, at 85 inches rad., twisted the joint about 15°, and permanent set began to take place at about half this amount, showing it to be good for a twisting moment of 42,500 inch-pounds. To compare the strength of the joint with that of the solid shaft, and ascertain accurately the elastic limit of the material, the shaft was turned down to 1¾ inches diameter, 6 inches long, and loaded as before by a weighted lever. In this manner the elastic limit of the journal was ascertained to be reached at 33,320 inch-pounds. When a permanent set of 20° had taken place the resistance was 57,700 inch-pounds, and when twisted 90° it was 66,940 inch-pounds.



SHAFT COUPLING.

If this load had been continued the joint would probably have twisted off. To compare the strength of the joint with that of the square shaft, we can say that for like defections a 2½-inch joint carries 85,000 inch-pounds, against 57,700 inch-pounds for a 1¾-inch journal. From this it appears that a 2½ inch joint is about equal in strength to a 2-inch journal. But a 2-inch journal has only 0.42 of the elastic strength of a 2½-inch square shaft, and, therefore, the joint under consideration may be said to have about seven-sixteenths of the strength of the solid shaft. The most that could be expected of a mechanical union of any kind would be 50 per cent., because half of one shaft must be cut away to make a joint for the other. Allowing 10,000 pounds fiber stress as a safe working limit, it appears from the foregoing that a good rule for the working strength of this coupling would be $B\ M = 1000\ d^3$, in which $B\ M$ = twisting moment, and d = side of square.

Having tested the joint for twisting, it was desirable that it should also be tested for bending, and a new joint was made for the purpose. This joint was clamped to a planer table, a long extension lever was added, and loads were gradually applied to determine the elastic limit and ultimate strength. No perceptible set took place until a load of 27,000 inch-pounds was reached, after which the set gradually increased, until at 108,000 inch-pounds it was evident that the ultimate strength would soon be reached. The joint continued to deflect, however, until 144,000 inch-pounds was reached, when it broke by shearing the rivets and prying off the upper part. Similarly, the solid shaft was tested and found to deflect permanently at 160,000 inch-pounds, and the deflection was continued until, under a load of 300,000 inch-pounds, it amounted to a bend of about 20°. Under this load the set increased so rapidly that it may be taken as a measure of the ultimate strength.

Here again the transverse strength of the joint appears to be nearly half as great as that of the solid shaft, but the elastic strength is less than one-fifth. This low elastic limit is probably due to the slip which takes place between the fitted surfaces, but even at 27,000 inch-pounds the joint is very stiff indeed, and up to all ordinary requirements. The only transverse strain that can come upon it is that due to imperfect alignment, and being placed, as it always is, near a journal, the flexibility of the journal can be made to relieve the joint. For this purpose the journal is made small enough to equal the joint in torsional strength, or 0.8 of the diameter of the square shaft, and it thus becomes flexible enough to relieve the joint without weakening the shaft. As an additional relief, the shaft is sometimes turned down on both sides of the joint to the diameter just given. The material used in these experiments was cold-drawn steel of very good quality. The elastic limit for torsion was about 33,000 pounds per square inch, and that for bending about 60,000 pounds per square inch.

In durability the joint promises well, but as it has in no case been in use for more than two years, it may be premature to say that it is quite equal to a weld. Thus far there has been no complaint that I know of against the present form of joint. To insure torsional stiffness and obtain large wearing surfaces it is customary to use large factors of safety, and the reduction of strength at the joints and journals is not often a serious matter, because the shaft would be just as large if welded. It may be said in conclusion that the joint is applicable to round shafts as well as to square. It is not expected, however, that it will supersede any of the common forms of couplings now used for shafting, but in special cases, where the ordinary coupling becomes a serious obstruction, this joint approaches in strength and stiffness all that can be expected of a mechanical union no larger in section than the shafts themselves.

A regular train on the New York Central is credited with having made a run of ninety-five miles in ninety minutes.

Automatic Gear Cutter.

On this page we give illustrations of a new automatic gear cutting machine intended especially for the heavier class of gear cutting, such as is required for electric railway motors, etc.

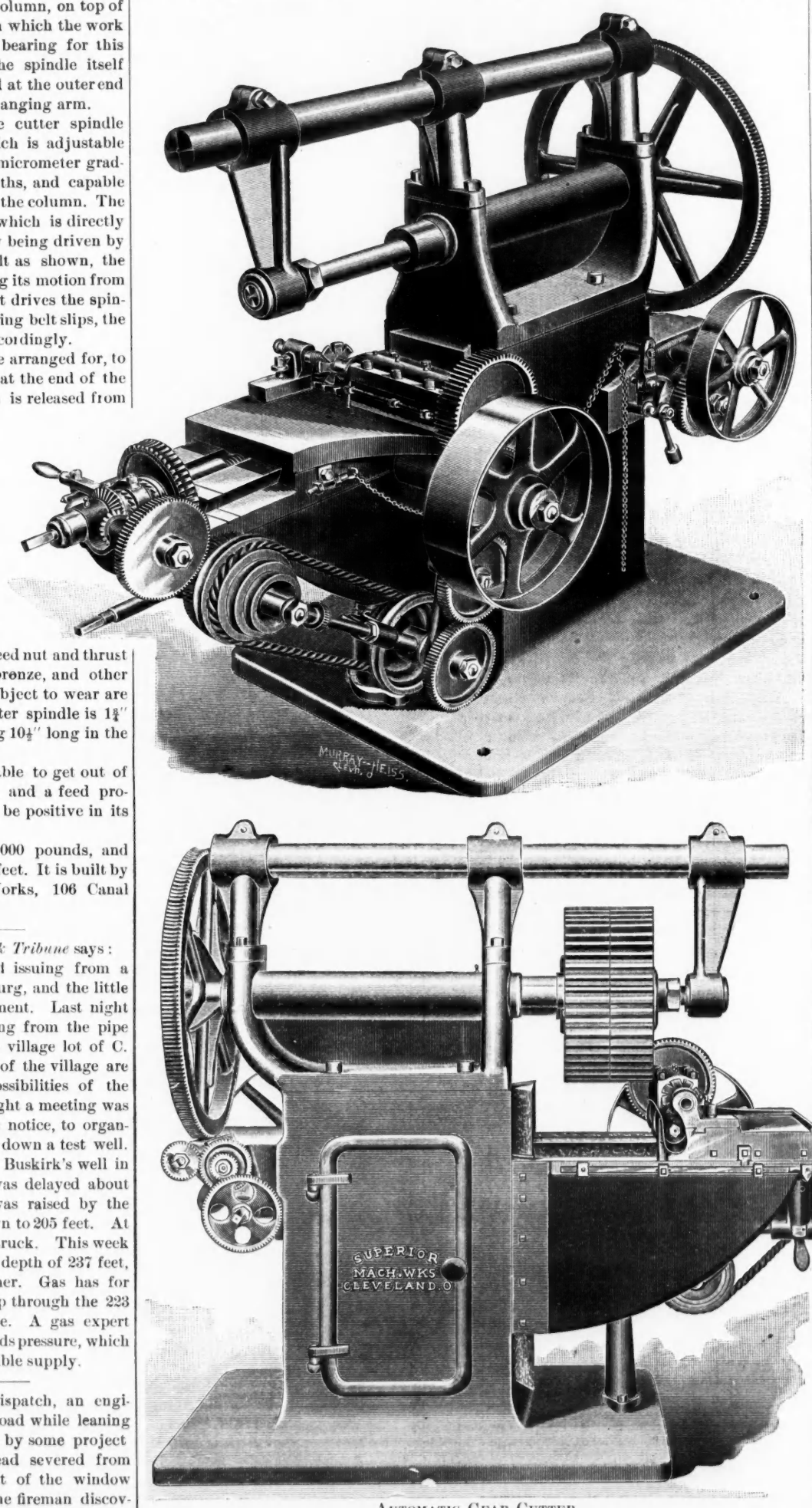
The general design of the machine will be readily understood from our two engravings, by which it is seen to consist essentially of a hollow rectangular column, on top of which is bolted the head in which the work spindle is supported, the bearing for this spindle being 25″ long. The spindle itself is of steel, and is supported at the outer end by a plain cylindrical overhanging arm.

The saddle carrying the cutter spindle slides on top of a knee which is adjustable vertically by a screw with micrometer graduations reading to thousandths, and capable of being clamped rigidly to the column. The saddle is fed by a screw which is directly under the cutter, the screw being driven by a worm-wheel and rope belt as shown, the driving rope-pulley deriving its motion from the same train of gears that drives the spindle, so that if the main driving belt slips, the feed stops or is retarded accordingly.

Eight changes of feed are arranged for, to suit all kinds of work, and at the end of the cut a double-ended clutch is released from the worm-wheel, and engages with the bevel gear in front of it, thus giving a quick return for the carriage, during which the wheel is indexed for the next cut, the indexing arrangement being driven by a belt from the countershaft, and controlled by the movement of the carriage, which has a travel on the knee of 13″. The feed nut and thrust bearing are of phosphor bronze, and other parts of the mechanism subject to wear are of steel, hardened. Cutter spindle is 1¾″ diameter, and has a bearing 10½″ long in the carriage.

Small intricate parts, liable to get out of order, have been avoided, and a feed produced which is claimed to be positive in its action.

The machine weighs 4,000 pounds, and occupies a floor space 3x6 feet. It is built by the Superior Machine Works, 106 Canal street, Cleveland, O.



AUTOMATIC GEAR CUTTER.

A special to the *New York Tribune* says:

Gas has been discovered issuing from a well in the town of Wellsburg, and the little village is wild with excitement. Last night a stream of gas was flowing from the pipe sunk in the ground on the village lot of C. E. Van Buskirk. Citizens of the village are enthusiastic over the possibilities of the newly-found gas, and to-night a meeting was held in response to a public notice, to organize a stock company to put down a test well.

The drilling on Mr. Van Buskirk's well in which oil has been found was delayed about two weeks ago, when $75 was raised by the citizens to put the well down to 205 feet. At 150 feet a vein of salt was struck. This week the drill stopped work at a depth of 237 feet, being unable to drill further. Gas has for several days been boiling up through the 223 feet of water to the surface. A gas expert says there is over 200 pounds pressure, which means an almost inexhaustible supply.

According to a press dispatch, an engineer on the Reading Railroad while leaning out of the cab was struck by some projecting obstruction, and his head severed from his body, which hung out of the window for some minutes before the fireman discovered what had occurred.

It is sometimes necessary for an engineer to lean out of the cab to get a better view ahead, or to the rear of his train, and no obstruction of any kind should be near enough to the track to prevent his doing it with safety.

The New Haven Railroad is making extensive arrangements for heating its cars by steam.

LETTERS FROM PRACTICAL MEN.

Cams, and Patterns for Them.

Editor American Machinist:

Delineating cam curves to accomplish certain results is a very interesting and instructive study in mechanics, and those who have read Prof. Wood's recent articles in the AMERICAN MACHINIST on this subject must have found it to be so.

None the less interesting is Mr. Booth's article, in your issue of August 27, on cam motions, in which he shows the way he got over a difficulty by the application of the cam motion in a peculiar manner. The idea is valuable—Mr. Booth is no poorer for "giving it away," and many of your readers may find it useful in their practice. His pleasure at seeing the draftsman swearing at the foreman pattern maker is not so commendable as his idea, and the draftsman was evidently anything but a cam designer.

The trick of casting a lead pattern and bending to the required shape need not reflect discredit upon any pattern maker, when it is practicable. I don't see why a pattern maker should scorn to do such a thing—Mr. Booth seems to think he would.

I remember very distinctly, in the place where I served my time, that lead and plaster of paris were often used to get peculiar shapes, but there were some things which could not be bent.

It is my opinion that Fig. 5 in Mr. Booth's article could not be bent in the way he suggests, because the ribs on the back of the plate would not only make it difficult to bend it, but the ribs themselves, not being concentric with the cone, could not be brought to the desired twist.

It seems to me that an easier way would be to bend the ribs and plate separately, and screw on the ribs. It has also occurred to me that the molder must have had some trouble in getting this twisted cam out of the sand; but perhaps the twist was not enough to give any trouble. If there was much twist, I would suggest plenty of draught on the outside of ribs, and also that the screws holding the ribs be taken out after the pattern is rammed up, allowing the ribs and plate to be drawn separately.

I offer these few remarks more as suggestions than criticism, thinking there may be some who would wish to apply Mr. Booth's valuable idea of the cam.

P. S. DINGEY.

Annealing Steel.

Editor American Machinist:

In your issue of Aug. 13, Question 363, S. T. W., of Mound City, Ill., wants to know how to soften tool steel so he can work it. His trying soapsuds, etc., is on the wrong side of fence; it is not so much in the cooling as it is in the heating, which makes a piece of steel soft. If he will heat his steel very hot, clear up to a nice lemon yellow, in fact, as hot as possible without burning it, he will have no trouble.

I usually bury the piece up in the green coal on the forge, which catches fire at once, and forms a shell of coke around it, then it cools down in a nest of fire; letting a piece lay in a forge all night, or all the month, for that matter, won't amount to anything unless it has been up to the proper heat.

This "water"-annealing and similar processes are all bosh; getting the steel up to the proper heat is the whole secret.

W. H. CHAPPELL.

[This may be all right for some steels, but such a heat as mentioned by Mr. Chappell would be fatal to the success of any annealing operation with most steels, which are made softer by being heated evenly up to a cherry red, and cooled slowly, than by any other means.—ED.]

Coal vs. Oil.

Editor American Machinist:

Reading your article in the AMERICAN MACHINIST of Sept. 10th, in regard to the cost of making steam with crude oil as compared with coal, I beg leave to offer a few figures on the subject.

In a large factory here in New England we use crude oil for generating steam, and for general forging, instead of coal, and a week's test of each to find the cost of same has given the palm to the oil, as follows:

For one week on coal the average consumption under two 80 horse-power boilers, per 24 hours, was 5 tons 200 lbs., and for the oil was 500 gallons for the same time—driving a hundred horse-power engine, and supplying steam to various other uses incidental to a shop of this class.

Now, at the present price of hard coal (which is used here when we have to burn coal), $4.75 per ton means a cost of $23.75 per 24 hours; and oil at 2¾ cents per gallon, $13.75 per 24 hours—making a saving of $10.00 per day, plus a fireman's wages, on coal, as one man does the work that it would take two to do on coal, besides saving the cost of hauling coal and carting ashes away, which are no small items in a year.

And the writer has often thought of the great saving both in labor and cost, if it was introduced on the Atlantic steamers, doing away with at least two thirds of the men it now takes in the fire-room of a large steamer, and saving lots of trouble when old firemen are scarce, and they have to ship green hands, as quite often occurs. And besides, an oil fire is more easily controlled than a coal fire; can be stopped or started in an instant, and, with the exception of the noise of the blast used in forcing it out of the burners, is not at all disagreeable, unless it is the smell, which a person soon gets accustomed to.

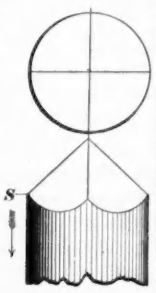
Being a marine engineer, I am somewhat interested in the subject, and would like to hear some one else's views on the subject.

NEMO.

Drilling Pottery Ware or Porcelain.

Editor American Machinist:

I notice an inquiry in a recent issue of your paper in regard to drilling crockery ware or porcelain. I have had some little experience with the material. I make a drill from a piece of drill rod the diameter of the hole I wish to drill, and grind either three or four facets on one end, like sketch, relieve it slightly from *s* in the direction of the arrow for from $\frac{1}{2}''$ to $\frac{3}{4}''$, according as the material is thicker or thinner than these dimensions. I do the relieving in lathe with smooth pillar file—harden as hard as possible and grind point after—lubricate with turpentine slightly. The glaze is hard to cut, but that through, it is easy work. On very hard pieces I make a small basin of paraffine over the point I wish to drill, and put a drop of hydro-fluoric acid in it, which eats the material and roughens it in a manner to enable the drill to bite or cut it; sometimes two or three applications of the acid are necessary. Care should be taken when coming through to prevent scaling off on the side opposite the start, the moment an indication of the drill point is seen; begin drilling from that side. The hole can be smoothed out by reaming with a square file of proper size, ground smooth on its sides, and in fact it is safer to bring the hole to size in this manner, I think.



Hartford, Conn. MACHINIST.

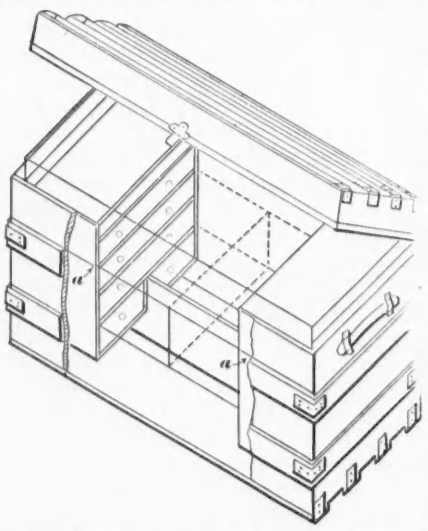
A Pattern Maker's Tool Chest.

Editor American Machinist:

In reply to your correspondent's request for a pattern maker's tool chest, I submit the inclosed for what it may be worth.

It differs from the "regular," in that the trays are at the ends. This distributes the weight more evenly, and it will be found more convenient to get at the bottom, back and front.

The case in which the drawers are held is not fastened directly to the trunk, but is held by a feather which is screwed to sides



of trunk, the ends of case being grooved to joint at *a* to receive them; here the case is hinged to fold into the center, to make room for cupboard, as shown. Your planes are kept at the front in the bottom; the cases resting on the ends of them will lock them in place should you do any traveling.

Should the cupboard not be required, a rack for your saws is put in the lid.

Elgin, Ill. GEO. S. CURRIE.

Editor American Machinist:

In response to the inquiry of a pattern maker who wants to see the best plan for a pattern maker's tool chest, I send a sketch of one that was constructed in the year 1866, and which has been copied by many mechanics who have seen the design. If it is worth a place in your columns, you may use it as an answer to your inquirer.

At Fig. 1 is shown the chest with the lid open, the sizes being given in figures. As will be seen, there is a small tool-box *a*, which can be lifted out and set on the end of bench. It contains three drawers for small tools. In front of this, in the chest, are the three tills *b*, *c* and *d*, which may also be lifted out and placed at the back of the bench. These tills contain places for tools, the appearance of one of them being shown at Fig. 2. These are readily kept in order, and it requires but a very short time to take out and arrange the tools for work, or to replace them in the chest, and lock it up. At Fig. 3 is shown a lid which is hinged to the top of the chest, and covers the tills when the chest is closed. The places for the heavier tools are shown upon it, and by having them thus arranged the outside lid is not burdened with their weight. J. F. E.

Heating Steel in Lead Bath.

Editor American Machinist:

G. M. B., Millersburgh, Pa., in Question and Answer column, asks about heating steel in lead to harden, and yourself and Mr. H. B. Hungerford have answered him.

Your suggestion to keep charcoal, which should be broken up fine, on top of the lead, is good, but I think Mr. Hungerford is right, that it has no use but to prevent oxidation of the lead. That is, however, a very good thing to prevent, as lead costs money, and a lot of it will burn up in a day, if exposed to the air at a red heat.

Mr. Hungerford advises the use of a paste of salt and flour, in which to dip the pieces to be hardened. Would it not be dangerous to put a wet piece of steel into hot lead, and should not the pieces be dried first?

File makers heat their files in lead, and I have been told that they use some kind of a mixture on them, to keep it from sticking, and I also think it is something that has a case-hardening effect, but I have never heard what it is. I have had a little experience in heating in lead, and I think it is a superior method, but, of course, it is not available in ordinary shop practice I do not think that either yourself or Mr. H. give the true reason why the lead sticks to the steel. It is my opinion that it is caused by some action analogous to brazing, and I think that if a clean piece of iron or steel is put into any kind of melted metal at a red heat, that it will adhere to the iron or steel more or less.

There is some affinity between all metals, and it is possible that some impurity present in the melted metal may have somewhat the effect of borax in brazing, or sal-ammoniac in galvanizing iron or steel; in other words, it may act as a flux. The pieces that I had occasion to heat in lead were cork-boring tools, being steel tubes about six inches long, from $\frac{1}{4}''$ to $2''$ in diameter, and about $\frac{1}{64}''$ thick. I found the lead was sticking to them in small particles about like half a shot, of different sizes, and that it could only be got off with a knife, or by filing. It was clean metallic lead, perfectly adherent, and seemingly soldered on. I got over the difficulty by heating the pieces over the fire enough to blue them, after which I had no further trouble.

The thin film of oxide, formed in bluing, kept the lead away from the steel, and entirely prevented it from sticking. Perhaps G. M. B. can do his work in this way.

H. K. PORTER.

An Engineer's Observations of the Vagaries of Lightning.

Editor American Machinist:

The slip in your issue of September 10, from the London *Globe*, seems to contain the old regulations for safety during thunderstorms, which have been handed down to us in the books since the time of Franklin; also the wire-cage theory. This latter was lately brought out by a professor in Harvard College, who wrote a story published in the *Youth's Companion*, in which the young hero—college educated, of course—was represented as humbugging a rich old woman, and finally getting all her money, with the help of a lightning screen, and the humbug part of it was put forward as the meritorious part of the operation.

This would seem to suggest the importance of establishing in our colleges a department of Humbugs, which might be dignified as the "Chair of Illusory Science."

The graduates, however, would find the world just as full of people in that line of business as any other, and so might regret the money paid out for their very elegant instruction.

But it was of lightning that I started to write about.

So far as I have observed, lightning does about as it pleases, regardless of any electrical laws; it seems to me more as if directed by some devil of mischief. I have seen a barn with a rod on every corner struck and burned.

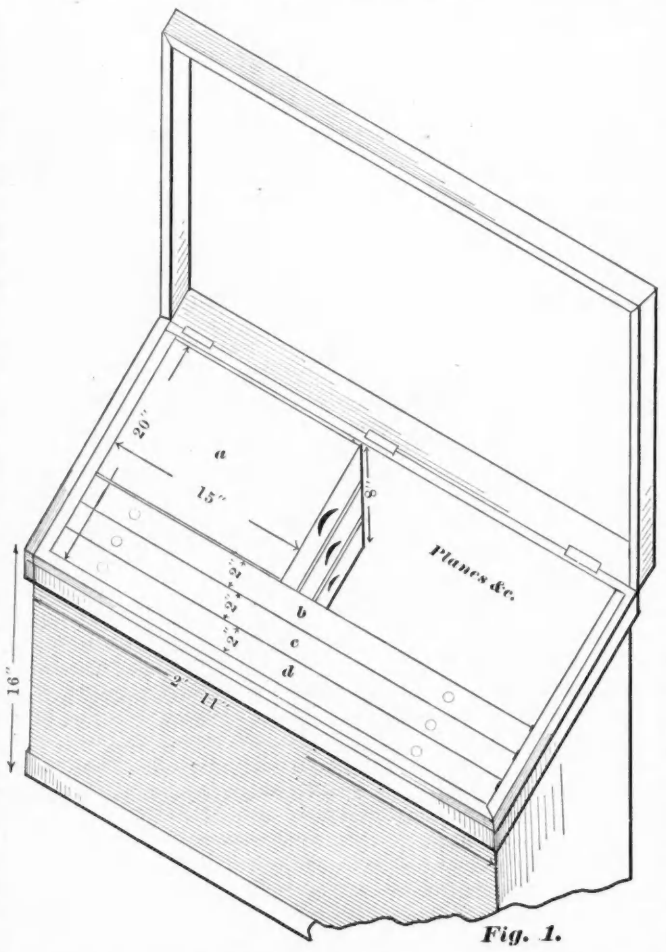


Fig. 1.

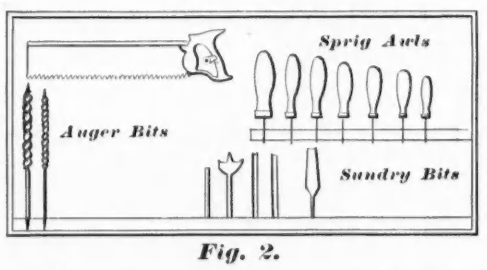


Fig. 2.

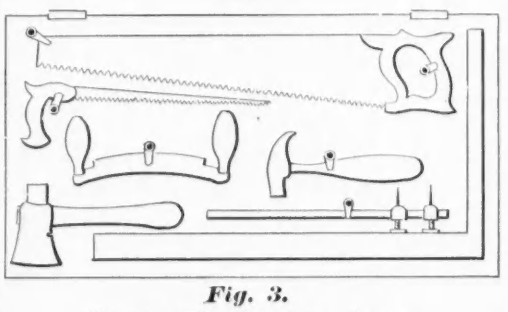


Fig. 3.

PATTERN MAKER'S TOOL CHEST.

I have seen a house, also rodded, which had a fine old elm in front; the lightning came down the tree, and then regardless of the "law," by which it should have passed through the green roots into the earth, plowed a rough and crooked furrow on top of the ground, ripped up the boards of the floor of the front room and porch, and left its marks on the bricks of an old, dry chimney, in its passage to the earth, traveling after leaving the tree over 15 feet of wet ground, 20 feet of old dry pine flooring, and 8 feet of old dry chimney foundation. Yet the books teach us that it should take the shortest and best conductors; hence lightning rods are provided, by means of which the charge should pass to the earth without doing harm.

I have seen in the South Atlantic Ocean a ball of fire pass from starboard to port, between the fore and main top-gallant masts of a bark-rigged war ship, and disappear with an explosion in the water a few hundred feet away.

This thing had to me the appearance of a red-hot 9" shot, so perfect was its shape; but its motion, as it sailed slowly along, was suggestive of something of light weight, like a foot-ball.

Now every naval vessel has a copper conductor, extending from the truck on each mast to the copper sheathing under water, and, according to electrical theory, some or all of these should have conducted the charge in the air quietly to the water. It may be said that this was a meteoric phenomenon, and not electric at all; but I know that the conditions of everything else were the same as we are accustomed to observe in ordinary thunder-storms, only far more intense than anything we have on shore.

Within a month there was a storm in this town, during which a house within a quarter of a mile of me was struck. As soon as the rain would allow, I started out to make an examination, which I have several times repeated.

There are two houses about 150 feet apart fronting on the same lane. House A is a large two-story house with a high-pointed roof, and, as to lightning rods, resembles the picture of Mark Twain's house after the agent got through with it; for the owner, although a church member, is much afraid of lightning.

House B is of very modest dimensions, has three chimneys and no rods, and this is the one that was struck.

Both houses are surrounded and overshadowed by old shade trees.

House B has a corner toward house A, entirely covered up by an old apple tree; it was at this corner, 15 feet from the ground, that the lightning went in. The occupants of house A saw a ball of fire come over their own house, and disappear in the old apple tree; they say they could hear it sizzle before there came the bang of the explosion.

There was no sign of any mark on the tree, and only a slight one on the outside of the house; the two upright boards, which form the corner finish of our wooden houses, were started a little by drawing the nails; one of these boards had at the angle a semi-circular notch jammed out of it about $2\frac{1}{2}''$ diameter, looking as though done by a rat.

Inside, the lath and plaster were driven off in the rooms up-stairs, the woodwork set on fire, and the frame of the building curiously splintered.

This room was used for storing some furniture, among other things some fine old feather beds, bearing the flavor of the dead bodies of the fine old birds that had supplied the filling.

Of course all this was badly shaken up, and the bedding set on fire, giving out an odor which the neighbors say was sulphur, but which I think was feathers.

There were two chimneys in this room.

and, according to electrical laws, this mischief-maker should have passed down one or both, as they are built up from the ground; but he did nothing of the sort; he made no other marks in the house, but at a point ten feet away from the store-room, and eight feet from the ground, is another one of his rat holes made between two weather boards, by which, after starting a slight fire, he escaped to the free air.

According to theory, this electric spark should have been arrested and taken to the ground by the conductors on house A; passing that some of the trees should have taken it, or having passed the trees some of the chimneys of house B should have taken it, none of which things occurred, as I have shown.

Regarding the occupants of the house—a lady and her daughter—the former was standing with her hand resting on a sewing machine, with her head within three feet of where the charge apparently passed away, and the latter near a cook stove. Of course, both were stunned, but gradually recovered, and are now as well as ever.

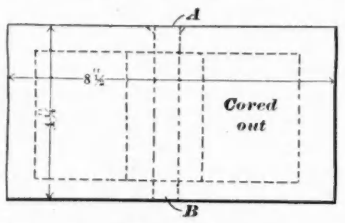
WILLIAM H. HARRISON.

Braintree, Mass.

A Phenomenon in Shrinkage.

Editor American Machinist:

We came across the "unexpected that often happens" a short time ago, and have been puzzled over it. A party brought in an engine cylinder and old piston cylinder to be rebored and put in new piston. We fixed up one of our piston patterns to suit, and had a casting made like sketch enclosed —8½" diameter, 4¼" long—it was put up and bored for piston rod, then reamed to $1\frac{7}{16}$", the hole being perfectly straight; the rod was then turned up for a shrink fit; we then put the piston in the fire and heated it; when hot enough it was taken out, and



found that the end *A* was large enough, but the end *B* for about ¼" was smaller than the reamer; we heated it as hot as advisable, but the hole seemed to get smaller; we finally had to cool it off, and when cold, on calipering the hole found it about $\frac{1}{32}$" smaller than the reamer that had bored it. As the work had to be finished that day we reamed it again, turned the rod to a driving fit, and drove it in with a heavy sledge hammer. Can any one account for that difficulty? My own theory is that the casting originally cooled unequally, and the cores were very hard, causing the outer metal to have a tension on it; the second heating equalized the whole mass, causing the central body of metal to be compressed.

SAMUEL T. WILLIAMS.

In the Engine-room.

Editor American Machinist:

The engine over which Jack presides is run condensing, using the jet condenser with air-pump connected with a rocker, the latter being operated with the usual side rod from the crank-pin. One morning a rubber gasket on mud drum hand-hold plate blew out, and that boiler had to be cut out. As three boilers were used with the full load on the engine, and they had no reserve, it made things lively for the fireman to hold the steam at 90 pounds. A new gasket was put on the feed-pump was speeded up, and the boiler was filled with hot water, and fired up. When the steam pressures were equal on the boilers Jack slowly opened the connecting valve. Before he was down the ladder steam was blowing through the engine-room, as the engine had lost the vacuum, and it was necessary to stop and re-start to regain it.

For a few minutes Jack was puzzled. He thought of entrained water, but the way the pipes were arranged shut out that theory. Ah, the air in the boiler—that must be the cause; reaching the condenser, and being in the upper part, it "broke" the vacuum. But was it not possible that this air would be so thoroughly mingled with the steam that the resulting mixture would be steam, and condensable? Hardly; for in the condenser the steam would be separated from the air, and be reconverted into water. Turning to Haswell, he found air consists of (by volume) oxygen 21, nitrogen 79, with the usual trace of carbonic acid gas, while water is composed of one part oxygen to two parts hydrogen. Therefore, while the air was mingled with the steam, yet at the condenser jet the twain were granted a hasty divorce.

As it was possible that a boiler might give out at some future time, and would be fired up and connected while running, he concluded that the air could be expelled by allowing the pressure to raise and steam to "pop off." To determine this he cut out one boiler that evening, and allowed it to cool over night. Next morning he allowed the air to freely enter the steam space. Satisfied that the steam space was filled with air, he fired the boiler up, and let the pop valve blow; when, the pressure having fallen until equal to that in the other boilers, the connecting valve was slowly opened, and to his satisfaction the condenser held the vacuum.

By the way, the Superior called the other day, and I took him out and introduced him to Jack, who is young and rather ignorant of such people. Generally the Superior is not a mechanic, or if one, of very indifferent knowledge of his own trade. But what he lacks on that point is more than made up by the knowledge he possesses on other subjects. The Superior looked over our nice engine, and told Jack about an engine in Kalamazoo with both heads nickel plated, and the rest silver-plated, and, with a remark about how men waste oil, he told of an engine of 300 H. P. which is run with a pint a week, and of the new rotary engine that for economy beats a triple-expansion, and can be built for the price of a wheelbarrow, and of the Louisville boiler with the tubes plugged with asbestos, and a current of electricity running through the tubes generating steam to run the dynamo, and 40 H. P. more; and the farmer's boy in Billskim County who has built a dynamo that runs a motor, and the motor runs the dynamo and a churn, and the boy never even saw a telegraph pole, and the triple thermic motor, and of Shayback's patent boiler that evaporates 15 pounds of ice water with a pound of poor slack, and of a genius he knows who has a sure scheme of putting the exhaust steam back into the boiler with only one pound back pressure; and then his eye chanced to fall on the vacuum gauge with the needle at 27", and he asked if that was the best we could get, as old man Pumpernickle always got 40". This settled Jack, and I took the Superior over to show him my new back-acting hitching-post, while he was describing to me an oil some railroad man has got up—calls it red light oil—that burns with a red light. I believe it will be a good scheme to get the Superior on some good enterprising daily paper, as any demand for mechanical facts can be met by drawing on his gifted intellect. CASEY.

Cost of an Education.

Editor American Machinist:

Allow me to reply to Question No. 403, in your paper dated September 10th, 1891, under Questions and Answers.

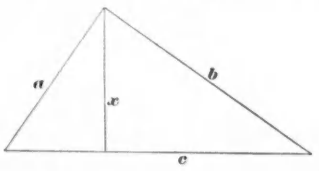
I would like to say that a boy with five or six hundred dollars—and even one-half that amount—can go to school and learn mechanical and civil engineering, and have money left after attending a complete course of four years at the Michigan Agricultural and Mechanical College, at Lansing, Mich. The institution provides for the students to work a part of the day, and pay their way almost entirely.

Enclosed please find a slip cut out of their catalogue, which will give you some light on the subject. I have been a constant reader of your paper ever since it started, and I am interested in helping boys who try to help themselves. R. L. FROST.

Solution of Triangle.

Editor American Machinist:

Looking over Questions and Answers of July of your valuable paper, I think it



might be of interest to add to "(342) F. E. F., New York," the following direct solution:

$$x = \frac{a \times b}{c} = \frac{a \times b}{\sqrt{a^2 + b^2}}$$

a proportion not mentioned in any book on elementary geometry, as far as I know, but perhaps as good as the other two commonly given. H. C. FISCHER.

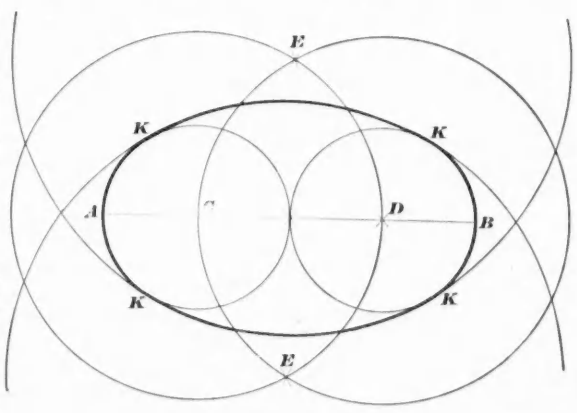
Forming the Ellipse.

Editor American Machinist:

In your issue of the AMERICAN MACHINIST [Sept. 3] was a cut, and a very elaborate description of how to form an ellipse. After careful study, I as yet fail to understand the author's method. When a boy, I learned the herein enclosed method of forming an ellipse, without using the high-flown "eight centered oval of the vertices, or the osculating circles of empirical constructed curvatures." Such language staggers the ordinary run of mechanics. The enclosed cut will explain itself. The dark lines form the ellipse, the light lines the method of forming it.

In the cut, *A B* is the given diameter. All the curves and circles are formed from this line, no matter what length the diameter may be. W. F. JONES.

[In deciding what to publish, and what not to publish in the columns of the AMERICAN MACHINIST, we have to consider that while the great body of our readers are of the best class of practical mechanics in the machinists' and related trades, yet there are many draftsmen and others who wish to know just such things as are shown by Prof. Honey in his communication, to which Mr. Jones refers. We do not admit articles which show an evident desire upon the part of the author to use unfamiliar terms for the sake of using them, but where the writing is as simple and direct as the subject permits, there can be no reasonable objection to the use of mathematical terms, the definitions of which are easily found by any who desire to know them. All so-called



ellipses which are formed of a number of arcs of circles joined together are really only approximations to ellipses, and as it is sometimes needed to secure a very close approximation, it is well to know how to do it. The method shown by Prof. Honey gives a much closer approximation than that shown by Mr. Jones, and though the latter might be close enough for nine cases out of ten occurring in the drafting-room, for the tenth one it might not do at all, and it might then be very convenient to know the method shown by Prof. Honey. Our readers now have both, and can make their choice. Other methods have been and will be published, and for those who are not satisfied with any approximation, there is Mr. Chas. A. Bauer's ellipsograph, which was illustrated in our issue of Oct. 20, 1883, and which draws a practically perfect ellipse, and the instrument can be made by any one who chooses, and has the necessary skill.—ED.]

Ruskin the Engineer.

Very few people are aware that John Ruskin, in addition to his brilliant literary work, has, on one occasion at least, played with remarkable success the part of a hydraulic engineer. The inhabitants of Filking, a little village in Sussex, not far from Brighton, had for a long time great difficulty in obtaining an adequate supply of drinking water. A hilly gathering ground was near, but nature seemed to have intended the water for other localities. All sorts of expedients were adopted to arrest the mountain streams, but one after the other proved a failure. It happened that Mr. Ruskin occasionally visited the district, and the idea occurred to somebody that he might be able to assist the villagers in their difficulty. The request was a strange one, but Ruskin began to think what could be done, and in the end devised a scheme which has given Filking as much water as it can ever hope to consume. Works have, of course, been required, but they did not cost very much, and they certainly do not disfigure the locality. The people have not been slow to show their gratitude for the boon thus conferred upon them, and near the well which gives the inhabitants a constant service they have erected a beautiful marble memorial, on which is a tablet bearing in gilt letters the following record: "To the glory of God, and in honor of John Ruskin. Psalm 78, 'That they might set their hope in God, and not forget to keep His commandments, who brought streams also out of the rock.'" —*Manchester Courier.*

A letter recently received at this office, from Charles Churchill & Co., of London, speaks of the rapid growth in popularity in England of American machine tools. They say that they expect shortly to issue a catalogue of American tools for use over there, which will be the largest and best book of the kind ever published in Great Britain. It will contain nearly 300 pages, as against 180 of last year's catalogue. They have engaged a large space in an electrical exhibition, which is to be held in Crystal Palace commencing January 1st, where they expect to make a very large display of American tools suitable for electrical work.

We learn that the report of the Board of Trade upon the accidents that have occurred on the railways of Great Britain during the year 1890 shows that the number of persons reported to the board as having been killed in the working of the railroads during the year was 1,076 and the number of injured 4,721. Of the number killed, 118 persons were passengers; and of the injured, 1,361 were passengers; but of these numbers only 18 were killed and 496 injured in consequence of accidents or collisions between trains. The remainder includes employes of the railroads, and contractors, suicides, trespassers, etc. The proportions of passengers killed and injured during the year from all causes is computed at one in 6,930,034 killed, and one in 600,840 injured. In 1889 the proportions were one in 4,236,000 killed, and one in 423,280 injured.

It is a rather common occurrence in Europe for about two hundred thousand men to be drawn away from their regular vocation in order that a great military display may be made. That is not the rule in this country, and is undoubtedly one of the reasons why men get more money for their work here than there.

A big panther recently put in some railroad work down in Florida that was not in the schedule. He attacked a track gang, fatally injuring one of them, while the rest rather ingloriously fled.

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FRED J. MILLER, }

Special Announcements.

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☞ Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.

☞ We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.

☞ We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.

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NEW YORK, SEPTEMBER 24, 1891.

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Insurance Should be Complete.

The testimony offered before the coroner's jury in connection with the Park place disaster, and the outcome of the inquest, must, we think, be acknowledged to be a disgrace to our civilization.

It was plainly apparent that the owner of the building wished to establish the theory of an explosion in order to be able to collect his insurance, and to avoid the payment of damages which he would be liable for in the event that the building had been proven unsafe. The tenants wished to establish the same theory in order to collect fire insurance, while the insurance companies and others wished to prove the contrary for various reasons, the result being some very absurd and contradictory testimony, and a verdict which settled nothing whatever, and throws no responsibility upon any one.

One of the things made evident, however, is that no building inspectors, presumably obtaining and holding positions by virtue of "pulls," instead of by merit and fitness for the work, can be depended upon in the least to properly inspect buildings, and cause the proper safeguards to be adopted.

It has been suggested, and we think the suggestion a good one, that insurance companies should assume risks of collapse as well as of fire, and institute a regular system of inspection, having special reference to avoidance of collapse from weakness or overloading.

Such a practice would at once remove any incentive, either upon the part of owners or insurance companies, to attempt to prove either one thing or the other, since the actual damage covered by insurance would have to be paid in any event, and the only interest any one could have in the matter would be to find out the true cause of the destruction of a building, in order to avoid it in future.

Such accidents are so rare that premiums for insurance against them need not be heavy, the chief cost to the companies being the first and subsequent periodical inspections to see that the rules were observed, and for this the owner ought to be more than willing to pay. One thing is certain, such an accident should be made next to impossible, and when one occurs the responsibility for it should be easily and certainly located.

Crossing Gates as Signals.

It ought to be understood that where gates are put up at the crossing of a street or wagon road with a railroad, these gates inevitably become signals to the people passing with teams. If they find them down they know, not only that it will be difficult or impossible to get across the road, but more than this, *i. e.*, that the watchman stationed there has seen a train approaching, and that it would be unsafe for any one to attempt to pass until that train has gone by. And, *per contra*, when they see the gates up they regard it as a safety signal, naturally thinking that the watchman, whose special business it is to watch for trains, knows that none are coming, and that it is therefore perfectly safe for them to pass, and they are very apt to do it without exercising the vigilance that they would exercise if there were no gates at the crossing. This fact makes the position of a crossing watchman all the more responsible, and also makes it important that the company employing him shall see that he not only can, but does actually perform all that is required or expected of him. In the case of a fatal crossing accident which happened on the New York Central road recently, it was shown at the coroner's inquest that the gateman was overworked, having two crossings and a signal to look after. This is something which should not be allowed, for people driving teams over railroad crossings are sure to regard the raised gates very much the same as a trainman regards a white flag, and unless gates are properly attended to it is much better not to have any, so that people approaching the crossing may understand that they must do their own looking for trains.

Increased Speed.

It is announced that on or about the 1st of the coming month the New York Central Railroad will put on a train between this city and Buffalo which will be the fastest train in America, it being expected that an average speed of 55 miles an hour will be attained for a distance of 441 miles.

It is found that, since the fast Western trains were put on this road, passengers for points in the State of New York take them in preference to any other trains, the result being that they are nearly always overcrowded during the first stages of their trips. The new train is to be specially adapted to the wants of travelers between the principal cities of the State, and it will be called the "Fast State" train. As a preliminary for this train, an experimental run was made over the road on the 13th, on which some very fast time was made, the train leaving New York at 7:36 A. M. and arriving in Buffalo at 2:56 P. M., covering the entire distance in 440 minutes, including stops, the actual running time being 426 minutes for the 441 miles. One mile is claimed in 48 seconds, which is at the rate of 75 miles per hour. We note that several papers, which fail to give the names of the enginemen making this run, state that Conductor Rockwell had the train in charge, as though that fact had some important connection with the speed attained. The conductor of a train has about as much to do with making time with a train or getting it safely over the road as the baggage-master has, and any one who knows anything of railroading whatever knows that the safety of a train and its speed depend almost entirely upon the engineer. The newspaper talk about conductors is about on a par with the glorification of captains of steamships when fast runs are made.

A Good Performance.

In our issue of Aug. 15, 1889, we illustrated a plant of vertical, direct-acting, high-duty pumping engines, with compensating cylinders, built by Henry R. Worthington for the Artesian Water Supply Co., of Memphis, Tenn.

These engines were tested by experts according to the terms of the contract, and the report of the test has just been published, making a very favorable showing for the engines.

The contract included the boilers, and one of the requirements was that the duty developed on trial must not be less than 105,000,000 foot-pounds for each 1,000 lbs. of steam at 110 lbs. pressure, steam to be taken as furnished to the engines by the boilers and fixtures. Boilers to have an evaporative efficiency of not less than 10 lbs. of water, from and at 212° Fahr., per pound of coal.

On the test, the duty given by the engines proved to be 117,325,000 foot-pounds per 1,000 lbs. of feed water, and all other requirements of the contract were considerably exceeded.

The contract seems to have been drawn in this case in such a way as to secure a high efficiency for the whole plant, including boilers, engines, and all other appliances.

We are sorry that it seems necessary for us to keep repeating the fact that we cannot pay any attention to communications which are not signed by the full name and address of the writer. A man in Ishpeming, Mich., sends us stamps in payment for a back number which he wants, and at the same time asks a question. He signs his initials only, and so we cannot answer the question, nor will the post-office authorities deliver mail addressed to initials only. All we can do in such a case usually is to wait for the "kick" which comes about not receiving the paper and not seeing an answer to question.

The Omaha Convention of the N. A. S. E. opened according to programme on September 1st, the meeting being well attended and successful in every way. The delegates were welcomed to the city by the mayor, whose address was responded to by Past President Fehrenbatch in an appropriate manner. The report of the committee on amalgamation with the Canadian association was laid on the table indefinitely, and may therefore probably be considered settled adversely. The committees on education and license made no reports. The meetings were well attended, and all who visited the city report having had a very good time. Other matters pertaining to the convention will be noted in a future issue.

A gigantic legal struggle seems to be impending between the Western Union interests and the Bell Telephone interests, the outcome of which will be watched with some interest, and may result in benefit to the public in some way. At present they are working under an agreement by which a monopoly is secured to each within its own field.

Literary Notes.

HANDY LIST OF BOOKS on Mines and Mining, Assaying, Metallurgy, Analytical Chemistry, Minerals and Mineralogy, Geology, Palæontology. An Alphabetical Reference Catalogue arranged under Authors and Subjects, and including Analytical References to the Contents of Important Works. Compiled by H. E. Haferkorn. Including issues from 1880 to May, 1891, and a number of Books published before 1880, frequently met with in Catalogues, together with a List of Periodicals and Annuals in these Branches, and a short List of important Works in the German Language.

The use of this catalogue will save much time and labor, as with it long, weary and irksome searches for the literature of a particular subject are avoided. Improvements indicated by experience have been added, making it more than fully up to the high standard of its predecessors. A great amount of care has been bestowed on making the entries and cross-references complete and detailed, with a view of increasing its usefulness as far as possible. The main entry of each work will be found under the author's name, containing full title, year of issue, publisher's or agent's name, editions, and price. The publisher or distributing agent of each book is indicated by a system of abbreviations at the end of the entry, which are explained in an accompanying key, containing the list of all publishers and agents represented. The authors' names are arranged alphabetically, and the subject headings are interposed in the same order, the whole making a single alphabetical series. With this arrangement the date of publication, publisher's name, and price of the book can readily be found, if the author's name or the subject is known; or if the latter is known, the number of books with the author's name treating on the subject will be seen at a glance.

We believe it is safe to say that in its arrangement nothing better can be desired, and it seems to us that no librarian, bookseller, or technical worker can afford to be without it. The catalogue is published by H. E. Haferkorn, Milwaukee, Wis. Price not given.

THE METAL WORKER ESSAYS ON HOUSE HEATING BY STEAM, HOT WATER AND HOT AIR. With Introduction and Tabular Comparisons. Arranged for publication by A. O. Kittredge, Editor of *The Metal Worker, Carpentry and Building*, etc.

This book is a reprint of a series of prize essays which were published originally in *The Metal Worker*, and contains illustrated essays on various systems of house heating, there being two on combination systems, four on steam heating, three on hot water circulating systems, and six on hot air systems. The terms of the competition required that these should be so complete that, with the drawings, they constitute specifications of the various systems from which they could be constructed complete, the whole forming a valuable and instructive exposition of current practice in house heating. As such it is valuable to those interested in the subject though, of course, it will be understood that principles are not discussed, and that one who had made no

other study of the subject would be unable to apply principles to practice in such a way as to attain success. Reasons are given for the adoption of specific constructions, however, and the reader is therefore able to trace the application of principles if he be previously familiar with them. The book is well gotten up, is 7"x10" in size, 288 pages, and sells at $2.50. David Williams, publisher, New York.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(414) J. G. H., McKeesport, Pa., writes: Kindly inform me through your columns which is the cheapest boiler that can be used satisfactorily for an engine with cylinder 2½ inches diameter and 3 inches stroke. Steam pressure is to be 50 pounds, and coal will be the fuel. *A.*—We should adopt a vertical tubular boiler.

(415) E. M. C., Brooklyn, N. Y., writes: I am making a set of patterns for a small steam engine with a cylinder 1½ inch diameter and 2 inches stroke. What I want to know is if the ports, which are necessarily small, can be cored? If not, how can they be made? *A.*—A good molder can cast the ports, but we believe the safest way will be to adopt such a design for cylinder as will permit the ports to be drilled.

(416) F. H. G., Columbiana, Ohio, writes: Kindly inform me through your columns how the threads are cast in some gas fittings, as elbows, tees, reducers, etc. *A.*—They are cast from patterns in the ordinary way. Manufacturers who make a business of casting these fittings have special appliances for the purpose, and they do not care to say much about all the details involved. 2. What is the rule for computing the area of ports, bridges and valve travel of common slide valve engines? *A.*—See our issue of May 1st, 1890.

(417) F. B., Pittsburgh, Pa., writes: I am about to try to construct a buggy, and I would like to run it by some power. I was thinking of using steam, but I think it will not answer the purpose. Now, what I would like to know is which is the best and cheapest power I could apply? I intend to construct the machine to weigh about 500 pounds, and carry two persons. Can it be run by a storage battery? If so, what size of motor and battery will it require, and what will be the cost per horse-power? Or, if a steam engine is to be used, what size cylinder and boiler will I require? *A.*—We should prefer a small steam engine; its size will depend on the kind of roads on which you intend to run the vehicle. You will save money by procuring drawings of one from a successful builder or from a good engineer.

(418) H. W. A., Boston, Mass., writes: Please let me know through the Question and Answer department in regard to the following: Is there any practical reversing gear other than the link, which could be used on a high-speed launch, up to say 50 or so horse-power? If there is any, where can I find the gear laid out, or a description of it which will enable me to design one? *A.*—Marshall's patent valve gear is often used in place of the ordinary link motion. Joy's patent valve is also applicable. These gears are illustrated and described in the Manual of Marine Engineering, by A. E. Seaton, in which is also shown the manner of laying out Marshall's gear. The same gear is also illustrated in our issue of July 18, 1889; and the manner of laying out Joy's valve is given in answer to Question 433, in our issue of November 13, 1890.

(419) H. W. W., Franklin, Pa., writes: Please tell me the number of square feet of heating surface of a boiler required for one horse-power, and how it is approximated. Also, where is the greatest pressure on the surface of a boiler when the gauge indicates 60 pounds? *A.*—For the approximation of heating surface see answer to Question 220, in our issue of May 14, current volume. The pressure, due to that of the steam, is the same on all parts of the boiler; but if the weight of the water is taken into account, then the lowest part of the boiler will have to sustain the greatest pressure. To find the pressure due to the weight of water in pounds per square inch, multiply the height of the water above that part of the boiler for which the pressure is to be computed by .434; the product will be the pressure sought; adding this to the indicated steam pressure will give the total pressure on the part of the boiler under consideration. In ordinary practice the pressure due to the weight of water may be safely neglected.

(420) C., New Orleans, La., writes: Please inform me what is meant by lead and lap of a valve in a slide valve engine. *A.*—The width of opening in fractions of an inch which the valve has given to the steam port at the instant the crank is on a dead center is called "lead." Assume the valve to be placed in its central position, then the distance that the valve overlaps the outside of the steam port is called the steam lap, outside lap, or simply lap. The distance that the valve overlaps (when in a central position) the exhaust edge of the port is called the inside lap or exhaust lap. Valves are sometimes so made that the steam is admitted by the inside, and exhausted by the outside edges. Hence the terms inside and outside lap are somewhat ambiguous; the terms steam lap and exhaust lap avoid this ambiguity, and are to be preferred. The exhaust lap is generally much smaller than the steam lap; it is frequently absent, and frequently the exhaust edge of the valve does not reach the exhaust edge of the port; in that case the width of the exhaust opening is usually called inside clearance, though a better name is negative inside or exhaust lap. 2. Is there any lead and lap on a Corliss engine? *A.*—Yes.

(421) G. W. D., Plattsburgh, N. Y., writes: Please answer through your columns the following questions: 1. Is there any chemical preparation which will remove India ink without destroying the paper, and where can it be procured? *A.*—We do not know of any such preparation, and believe that there is none made. 2. Why will a hollow column hold more weight than a solid one? Does it depend on the construction? That is to say, a solid column bored out, or one cast hollow. *A.*—The failure of columns is apt to occur by a sidewise bending, which induces transverse stresses and causes the material to be highly strained under the combined compression and flexure. Hence it is easily seen that a column of large diameter is more capable of resisting transverse stresses than one of a smaller diameter, both being equal in length. If, now, two columns, one solid and the other hollow, are made of equal weight and length, the hollow column will be larger in diameter than the solid one, and therefore the hollow one will resist a greater transverse stress than the solid one, hence it follows that the former can sustain a greater load than the latter. If, on the other hand, a solid column is bored out, it will not be as strong as in its solid state. Hollow columns are always cast hollow; they are not bored out.

(422) W. S. & Co., Atlantic City, N. J., write: We have a vertical pleasure wheel 40 feet diameter, 6½ feet wide, with 16 coaches; weight about 10,000 pounds. We want to run the wheel at four revolutions per minute. In loading the wheel it takes considerable power, because the weight is all on one side; after we have loaded it, not so very much power will be required. We want to put two persons in each coach; the shaft in wheel is 3½ inches diameter. Which would be the best and easiest way to run this wheel? And how many horse-power will it take to hoist all this weight up by loading? I would like to know how to compute the horse-power required? *A.*—The horse-power will not only depend on the weight of the persons, but it will also depend on the weight of the coaches and on the manner in which they are suspended, of which you have said nothing. We should also know whether the wheel is to be loaded at the bottom or at the side, as less power will be required when loaded at the side than at the bottom. To compute the horse-power required for starting the wheel when partly loaded is not a simple matter, and we should earnestly advise you not to attempt to be your own engineer, as lives will be endangered, but engage a first-class engineer who will make the necessary computations, select the right kind of engine for you, and make the necessary plans for erection. For running the wheel we should use a worm wheel on the wheel shaft and a worm on the engine shaft. With a worm and wheel you will obtain a good control of the motion of the wheel, but considerable power will be required to overcome the friction.

(423) R. C. W., Palestine, Texas, writes: In your formula to calculate the horse-power of an engine you multiply the area of piston in inches by the length of stroke in feet. Will you please tell me through the columns of your paper why this is, as it seems contrary to all mathematical rules. *A.*—We do not multiply the area of the piston in *inches* by the length of stroke in **feet**, but we do multiply the area of piston in *square inches* by the length of stroke in feet. The steam gauge indicates the pressure per square inch, consequently to compute the total pressure exerted on the piston we must multiply its area in square inches by the indicated steam pressure; the result is the total pressure in pounds on the piston; for instance, if the area of the piston is 150 square inches, and the steam pressure is 60 pounds per square inch, the total pressure on the piston is $150 \times 60 = 9{,}000$ pounds; if, now, the stroke is 2 feet, then the amount of work performed during one stroke will be $9{,}000 \times 2 = 18{,}000$ foot-pounds, and if the engine runs at a speed of 100 revolutions per minute it will make 200 strokes, and the work performed during one minute will be $18{,}000 \times 200 = 3{,}600{,}000$ foot-pounds. The reason for computing the work performed in foot-pounds per minute is that the unit for measuring the horse-power is always 33,000 foot-pounds of work performed in one minute; hence in the example given we divide the total work performed in one minute by 33,000, and we have $\frac{3{,}600{,}000}{33{,}000} =$ 109.09 horse-power. 2. Please give me some idea as to how to calculate the difference between the boiler and the cylinder pressure. *A.*—See our issue of June 9, 1883.

(424) S. B. R., Watsonville, Cal., writes: Please give me, through your columns, rules for calculating the dimensions of piston rods and connecting rods. *A.*—For computing the diameter of a piston rod see answer to Question 408, in our issue of September 10, current volume. For finding the diameter of a connecting rod the following empirical formula will be found a very useful one, and the results given by it agree very closely with modern practice: Diameter of connecting rod at middle in inches $= \frac{\sqrt{L \times K}}{4}$

In which L is the length of the rod in inches, and $K = 0.03 \times$ Effective load on the piston in pounds. This formula expressed in words reads: Multiply the length of the connecting rod in inches by the value of K as found above, and extract the square root from the product; divide this result by 4; the quotient will be the diameter of the connecting rod in inches at the middle. To illustrate: What should be the diameter of a connecting rod 80 inches long for an engine with a cylinder 16 inches diameter? The effective pressure is 120 pounds per square inch. The area of a piston 16 inches diameter is 201 square inches (here we have neglected the very small fraction). Hence the total effective pressure on the piston is $201 \times 120 = 24{,}120$ pounds. In this case, $K = 0.03 \sqrt{24{,}120} = 4.65$. And the diameter at the middle will be: $\frac{\sqrt{80 \times 4.65}}{4} = 4.8$ inches. The diameter of the connecting rod at the ends may be found by multiplying the diameter in the middle by 0.875. In the above example we have found the diameter at the middle to be 4.8 inches, hence at the necks it will be $4.8 \times 0.875 = 4.2$ inches. Some engineers make the diameter at the crank-pin end somewhat larger than at the crosshead pin end, and find the diameter by multiplying its middle diameter by 0.925; according to this, the diameter at the crank-pin end will be $4.8 \times 0.925 = 4.44$ inches, 4.8 inches at the center, and 4.2 inches at the crosshead pin end.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

George B. Grant—Gear Wheels. See p. 20.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Ice and Refrigerating Machines, 170 sold, and all successful. David Boyle, 521 Monroe St., Chicago, Ill.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Valve Seat Rotary Planing Machine. Pedrick & Ayer, Philadelphia, Pa.

Cylinder Boring and Facing Machines. Pedrick & Ayer, Philadelphia, Pa.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

$13.00 I. Dea L. Drawing Stands. The original. Send for postal. W. S. Rogers, Troy, N. Y.

To get the best work out of a Star Hack Saw, bear down heavily, and draw it very slowly.

S. A. Smith, 23 So. Canal St., Chicago, Ill., agent for Appleton Mfg. Co.'s Emery Grinding Machinery

Our Automatic Gear Cutting Machine will increase production 50%. The Superior Mach. Wks., Clev'd, O.

Boston Gear Works, Boston, Mass. Gear cutting of every description; noiseless gears a specialty.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

For the latest improved Eccentric Hook, Connecting Rods and Stub Ends, address T. C. Dill Machine Company, Philadelphia, Pa.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal St., Chicago, Western Agent.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 198 Jackson St., Chicago, Ill.

Save small iron from foundry refuse. It pays. Use the Woodruff Pat. Separating Machine, Audubon Machine Works, New Haven, Conn.

"Twenty Years With the Indicator," by Thomas Pray, Jr. 10,100 sold. Price, $2.50. Order of bookseller; take no other.

Hyd. press, hyd. jacks, steam tables, accumulators, cutting and stamping dies for sheet metal, foot press, etc. S. Hartley, 245 N.J.R.R.Ave., Newark, N.J.

Self-adjusting Hand-Screw for Pattern and Cabinet Makers, Wood Workers, etc. Sample by mail for 50 cents. Wm. H. Denney, Lancaster, Pa.

Upright Drills and Iron Planers, for immediate delivery; prices reasonable. J. E. Snyder, Worcester, Mass.

Valuable Books for Machinists and Engineers. Send for complete Catalogue to Norman W. Henley & Co., 150 Nassau Street, New York.

25", 32", 37", 42" — "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

The Corliss Engine, by John T. Henthorn: A Manual especially adapted for every-day use. $1, free by mail. Egbert P. Watson & Son, 150 Nassau street, New York.

Complete treatise on Screws and Screw-making, with clear and concise explanation of the methods; 95 illustrations. Price, $1.25 postpaid. E. & F. N. Spon, 12 Cortlandt Street, New York.

Do you wish to become an expert engineer? Hawkins' Hand Book of Calculations will greatly aid you. 10 parts, 25 cents each, or in 1 volume, $2.50. Catalogue. Theo. Audel & Co., Publishers, 91 Liberty St., New York.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Progressive Examinations of Locomotive Engineers and Firemen," by John A. Hill, editor of *The Locomotive Engineer*, is a new pocket edition of a practical work for locomotive enginemen, by a man with ten years of foot-board experience. Nearly 600 questions and answers, colored plates showing position and color of all signals carried. Price, 50 cents. John A. Hill, Box 1736, New York.

Club Rates.—If no one is getting up a club for the AMERICAN MACHINIST in your town or establishment, send for Circular of New Club Rates, and try it yourself. Address AMERICAN MACHINIST, 96 Fulton St., New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

MANUFACTURES

The iron-mills at Parksburg, Pa., are being rebuilt.

Machine repair shops will be established at Morgan, Tex.

It is reported that machine repair shops are being erected at Morgan, Texas.

An electric light plant will be erected at Galloway, Ark. W. F. Carter can inform.

Forquer & Tooke will erect an iron and wood-working establishment at Myers, Fla.

An addition is to be built to the works of the Victoria Cordage Company, at Dayton, Ky.

The New Berne (N. C.) Ice Company will put in machinery to double the capacity of its ice factory.

The Franklin Brass Works, Buchanan, Va., recently burned, will, it is stated, be rebuilt at once.

A rolling-mill will probably be established at Bluffton, Ala. W. M. Brewer can give particulars.

The city council will be petitioned to build a bridge across Nineteenth street, in Birmingham, Ala.

A new dynamo is probably to be purchased by the electric lighting company at West Troy, N. Y.

A new county bridge is to be built across the James River at Lick Run, Va., at a cost of about $6,000.

Louis Schultz, of New Orleans, has secured permission to erect and operate an iron forge at that place.

The Citizens' Rapid Transit Company, Nashville, Tenn., is reported as to establish an electric light plant.

The Avonmore Foundry and Machine Company, of Avonmore, Pa., has been incorporated; capital, $70,000.

The Victoria (Texas) ice factory is reported as to be equipped with an entire outfit of new machinery.

A new concern at Lowell, Mass., is the Eagle Foundry Company, manufacturing iron and brass castings.

An iron bridge is to be built across the Contoocook River, between Antrim, N. H. and Bennington, N. H.

An ice factory and cold storage plant are under consideration by the board of trade of Arkansas City, Ark.

The rolling-mill and the nail factory of the Mount Hope Iron Works at Somerset, Mass., started up on the 8th inst.

The Woonsocket (R. I.) Machine and Press Company has been making quite extensive additions to its works.

The Pitman Manufacturing Company, of Laconia, N. H., are to build new buildings, at the expense of about $20,000.

The Raleigh (N. C.) Plate Ice Company states that it will most likely rebuild its ice factory, recently burned.

The Fort Mill Manufacturing Company, Fort Mill, S. C., will, it is stated, put new machinery in its cotton-mill.

Efforts are being made to organize a stock company to establish an electric lighting plant at Jonesboro, Ark.

Capital for the reorganization of the Taylor Manufacturing Company, at Chambersburg, Pa., has been raised.

A stock company will, it is stated, be incorporated for the purpose of erecting an ice factory, at Yazoo City, Miss.

The St. Joseph (Mo.) plant of the St. Joseph Bridge and Boiler Company is soon to be removed to Pueblo, Colo.

The West End Rolling-mill Company, of Lebanon, Pa., have increased their capital stock from $80,000 to $100,000.

The Lowell (Mass.) Steam Boiler Works, recently destroyed by fire, are to be rebuilt at once on a much larger scale.

The New York Manufacturing Company, of Saco, Me., is to add new automatic machinery to their finishing department.

A new fertilizer and phosphate factory is talked of at South Jacksonville, Fla. J. S. Smith, Jr., is one of the projectors.

It is stated that the pump and wind-mill manufacture is to be established on a very extensive scale at Ypsilanti, Ohio.

The Brosius Sewing Machine Company, Atlanta, Ga., will, it is stated, double the capacity of its sewing machine factory.

The Penn Iron Works, at Lancaster, Pa., have resumed work, after ten weeks' suspension. They give employment to 300 men.

A well-appointed foundry and machine shop, and an ice factory, have been recently established at Jeanerette, La., by A. Moresi.

The Novelty Knitting Machine Company is the name of a concern about to start up at the machine shop at Chelmsford, Mass.

The Lorraine Manufacturing Company, Pawtucket, R. I., have begun to erect a new building, 40x36 feet, and two stories high.

Some new machinery, including engine, boiler, etc., is to be placed in the Metropolitan Street Railway Co.'s plant at Macon, Ga.

Rumor has it that M. E. Ingalls, now in Europe, is arranging for the erection of a large iron-working industry in Clifton Forge, Va.

It is stated that the railroad machine shops now located at Tulare, Wash., will be removed to Bakersfield, same State, about Oct. 1.

Work on the aluminum works near Bryant, Ark., will be commenced October 1, by the Philadelphia parties having the project in charge.

The Goodrich Spring Gun Company has been organized at Chicago, with a capital stock of $30,000, by Joseph Goodrich and others.

The S. K. Page Lumber and Manufacturing Company, of Harriman, Tenn., is in the market for a general line of wood-working machinery.

C. J. McKenzie, of Wauseon, Ohio, is authority for the report that works for the manufacture of pumps are to be built at Toledo, Ohio.

The Waukegan Iron and Steel Castings Company, of Waukegan, Ill, expects to have the works at that point in operation by November 1.

The Lawrenceburg (Tenn.) Land and Mineral Company contemplates erecting a steam power plant, to furnish power to small industries.

A new management will take hold of the South Tredegar Iron Works, Chattanooga, Tenn., so it is reported, and the plant be greatly improved.

There is water-works agitation in Towson, Md.: Tuscola, Ill.; Wheeling, W. Va.; Alliance, Ohio; Plainfield, N. J.; Lancaster, Pa.; O'Neill, Neb.

An ice manufacturing company, with a $40,000 capital, is in process of organization at Pine Bluff, Ark. Its output will be twenty-five tons a day.

The organization of a company, to erect a wheel factory at Memphis, Tenn., is projected. Secretary of Commercial Association can give information.

It is a probable that a $50,000 stock company will be organized at Spartanburg, S. C., to manufacture a ditching machine invented by C. F. Christopher.

The brickwork on the new Keating Wheel Factory, at Holyoke, Mass., has been begun. The company expects to occupy the building Oct. 15.

The Goshen (Va.) Car and Railway Equipment Company has been reorganized, with G. W. Talbott as president, and G. H. Fitzwilson, vice-president.

The Milwaukee Bridge and Iron Works, Milwaukee, Wis., were sold at public auction last week by Assignee Townsend to Julius G. Wagner, for $80,000.

Work on a hammer shop, a producer house and a boiler house to be added to the Boies Steel Car Wheel Company's works at Scranton has been begun.

The Blake & Johnson Co., of Waterbury, Conn., are about completing a new machine shop, 200x45 feet, two stories high, with basement and storage-rooms.

It is stated No. 1 furnace of the Pioneer Mining and Manufacturing Company, Thomas, Ala., shortly will go in blast. The furnace has been out for repairs.

It is stated that the city of Bristol, Tenn., will make a proposition to a Philadelphia (Pa.) party looking to the establishment of a steel plant in Bristol.

The Enterprise (Miss) Manufacturing and Development Company has, it is stated, completed financial arrangements for the erection of a cotton-mill.

Northern parties are reported as offering to remove their cotton-mill to Newport News, Va., provided the citizens will subscribe $10,000 in stock to the plant.

The organization of a stock company for the purpose of erecting an electric light plant is talked of at Towson, Md. F. L. McAleese can give information.

The factory of the Farr Alpaca Company at Holyoke, Mass., is to be lighted by electricity by its own plant, for which preparations are now being made.

Monroe County will build an iron bridge across Indian Creek at Red Sulphur Springs, W. Va. J. C. McClaugherty, county clerk, Union, W. Va., can be addressed.

The Solid Steel Company, of Alliance, O., is reported to be preparing to double the capacity of its plant, on account of the increase in its orders for steel castings.

The Pottsville Insulated Wire Company, of Philadelphia, have been chartered at Harrisburg, Pa., to manufacture insulated wire and cables, and electrical appliances.

The Baltimore City Cold Storage and Warehouse Company, Baltimore, Md., has, it is stated, purchased for $25,000 property on which it will erect a cold storage plant.

The main building of the street car plant of the American Car Company, of St. Louis, is completed, and the engine-room and blacksmith shop are now under construction.

The Chattanooga Foundry and Pipe Works, of Chattanooga, Tenn., has completed its branch pipe works at Bridgeport, Ala. The plant has a daily capacity of 100 tons.

The Indiana Novelty Works, of Plymouth, Ind., is erecting an extensive brick factory building at that place, for the purpose of manufacturing "anything in the line of wood."

The St. Louis Steel Foundry Company has established the manufacture of open-hearth basic steel, by the Siemens-Martin furnace, in its newly rebuilt plant in East St. Louis.

The Automatic Clock Register Company, of Chicago, Ill., has been incorporated, with a capital stock of $250,000. Incorporators are S. W. Gehr, A. B. Holson and J. J. Wright.

The Ross-Meehan Brake Shoe Foundry Company, Chattanooga, Tenn., has purchased the machinery of the old Globe Iron Works, at Sheffield, Ala., and will remove it to Chattanooga.

It is reported that Boston parties have been in Providence, R. I., of late, looking at the Oriental Mills estate, with a view to using the property for manufacturing purposes again.

G. J. Buckey, of Frederick, E. L. Keller and others have organized a stock company to establish plow works at Buckeystown, Md. It will be known as the Buckeystown Plow Works.

The McColl Cotton Manufacturing Company, at McColl, S. C., lately organized to erect a cotton-mill, has been incorporated by T. B. Gibson, A. W. Morrison, F. P. Tatum and others.

The Mills Improved Pneumatic Brake Company, of Chicago, Ill., was incorporated in Illinois, last week, with a capital stock of $600,000, by W. Mills, W. B. Mills and O. A. Bogue.

The new shops of the New York Central, at West Albany, N. Y., to replace those burned last May, are nearing completion. Considerable new shop equipment will be purchased.

Baltimore capitalists are, it is stated, negotiating for the establishment of a steel plant in Goshen, Va. The Goshen Land and Improvement Company can probably give information.

Stough, Cornelius & Co., Davidson College, N. C., have added to their mill a building 100x50 feet, and placed orders for 2,000 spindles. They will put in an automatic sprinkling outfit.

At Attalla, Ala., W. G. Lunsford, of Birmingham, has purchased property on which to erect a foundry and machine shop. He is in the market for planer, lathes, boring-mill, bolt machine, etc.

The foundry at Somerset, Mass., was sold at auction recently to parties who will organize as the Somerset Foundry Company, and resume work at once. The price paid was $5,280.

The Belden Machine Company, of New Haven, Conn., is constructing a new four-story brick building, 190x93 feet. The new machine shop will be fitted with the latest improved machinery.

The Kershaw County Manufacturing Company, of Camden, S. C., has decided to build a 10,000 spindle-mill, and the contract for it has been placed with Lockwood, Greene & Co., of Boston.

The work of rebuilding the Alabama rolling-mills at Gate City, Ala., is progressing rapidly. The plant will be greatly enlarged, and no expense spared in making it among the best in the South.

The National Car Wheel Company has been incorporated at Chicago, Ill., for the manufacture of car wheels; capital stock, $100,000; incorporators, Chas. L. Billings, Albert E. Peters and George Piton.

W. H. Bradshaw, W. H. Jones, Jr., C. W. Jenkins and others have incorporated the Bradshaw Lumber Company, to establish electric light plants, gas works, etc., at Suffolk, Va. The capital stock is $50,000.

The Canda Manufacturing Company is reported to have purchased a large tract of land at Carteret, N. J., on the line of the Central Railroad of New Jersey, on which a car manufacturing plant will be erected.

The plans have been drawn for the roller-mill building to be erected at Milan, Tenn. It will have four stories, the first of brick, the others of plank or iron. Work will begin as soon as a deed to the land is secured.

The Piedmont Machine Company's plant, at Piedmont, W. Va., began operations recently, turning out the first casting from its foundry. Everything worked smoothly and satisfactorily, and the works are now operated in full.

There will be an addition of 300 feet built to the eastern end of the present large machine shop of the ordnance department of the Bethlehem Iron Company's works, at Bethlehem, Pa. Several additional buildings will be erected.

The Chicago (Ill.) Equipment Company has been formed, to manufacture and deal in cars, locomotives, rails and all kinds of railroad supplies; capital stock, $1,000,000; incorporators, R. H. Pugh, R. Wilbeforce and H. S. Monroe.

The town of Peterborough, Ont., has voted a bonus to Patterson & Corbin, late of St. Catharine's, to establish their car works in that place, and the industry will be removed there without delay.—*The Canadian Manufacturer.*

The Enterprise (Miss.) Manufacturing and Development Company has made arrangements for the construction of an iron furnace of 50 tons capacity, and the erection of a cotton-mill to cost $500,000. Work is to commence about January 1st.

Charles Bickford, of Boston, contemplates the manufacture of mantel clocks at New Bedford, Mass. He has met with some degree of success, and it is possible he may raise a capital of $100,000 to begin the manufacture of these clocks.

The Waukegan Iron and Steel Castings Company has been organized at Waukegan, Ill., and is now preparing for business, and probably will be in operation by November 1. The company contemplates introducing the Bates process for steel castings.

It is reported that G. W. Goddard, of Roanoke, Va., has organized a stock company to build a rolling-mill. The company, it is said, has optioned 40 acres of land, and the Virginia Construction Company, recently chartered, is reported as to erect the building for the plant.

The New Jersey Railroad Signal Company, of Newark, N. J., has been formed, with capital stock of $50,000. J. Dawson, of Kearney, N. J., and J. Wayland and W. H. Buckley, of Newark, are the promoters of the company, which will manufacture and sell railroad signals of all descriptions.

Press dispatches from Springfield, O., announce that the Central Car Repair and Manufacturing Company has failed to make the first payment on its purchase of the Whitley Reaper Works, at Springfield, and the works have been again offered for sale, with what success is not yet known.

The Lukens Iron and Steel Company, of Coatesville, Pa., are about to erect an open-hearth steel plant, consisting of two 15-ton acid open-hearth furnaces of the standard Siemens type for the manufacture of ingots for their plate-mills. They expect to have the plant in operation in about six months.

The entire plant of the Youngstown Bridge Company, at Youngstown, Ohio, was destroyed by fire on Thursday, Sept. 3. The loss is estimated at $75,000, with an insurance of $60,000. Immediately after the fire a meeting of the board of directors was held, and it was decided to rebuild the plant at once.

Mr. R. McKechine, Dundas, Ont., is building an extensive machine shop, which he expects to have completed and in operation next month. The molding shop is completed, core ovens and cupola have been erected, a new floor bed laid, and now new machinery is being put in.—*The Canadian Manufacturer.*

The Montreal Metal Works has been incorporated at Montreal, Canada, with a capital stock of $50,000, and will manufacture and deal in wires, rods, cables, and every description of apparatus and metals used in connection with the business of telephone, telegraph, electric lights, electric railway, cable companies, etc.

The tin-plate manufactory at Apollo, Pa., is producing plates 28x100 inches, which is five times as large as the Welsh plates, which were only 20x28 inches. The new size is said to be much more desirable for roofing purposes, and those who have seen it say it is "of the best steel, fully coated, redipped, and without a blemish."

The Brass and Iron Works Company, of Fostoria, O., is making extensive additions to its plant, the present works being inadequate to the demand. The company makes a machine for tapping pipes while under heaviest pressure, as also for dry pipes, and has lately added to its lines the entire well drill machine department of the Wells Machine Company.

The Sterling Emery Wheel Company, formerly having works located at West Sterling, Mass., but now located at Tiffin, Ohio, are just fitting up their new factory building at the latter place, to replace the one burned about six months ago. They get natural gas by contract for their kilns, heating, power, and all purposes, at a nominal rate. L. Best is general manager.

The Salt Lake Stamping and Tinware Company has been organized in Salt Lake City, Utah, with a capital stock of $100,000 to manufacture tinware. The officers of the company are as follows: W. D. Woodbury, president; Joseph Jacobs, vice-president; Geo. Sherman, treasurer; J. N. Simpson, secretary and general manager. The company will employ between 75 and 100 men.

Coates & Co., of the Locust Point Iron and Steel Works, Baltimore, Md., inform us that they are erecting two mills for the manufacture of tin-plate, with a capacity of 1,500 boxes per week. The engine power is for six mills, but owing to the uncertainty as to whether the present tariff will be sustained, they are going ahead rather slowly. They expect to be making plates in 90 days.

The American Tin-plate Company, organized for the purpose of manufacturing tin-plate and sheet-iron, near Elmwood, Ind., has been incorporated under the laws of Indiana, with a capital of $300,000. The directors are A. L. Connor and W. S. McDonald, of Akron, O; M. Sieberting and W. B. Leeds, Kokomo, Ind.; P. G. Reid, Richmond, Ind.; John T. Hosen, Cincinnati; and James L. Overman, Elmwood.

At Kingston, N. Y., the Peckham Street Car Wheel and Axle Company, who have recently been reorganized as the Peckham Motor Truck and Wheel Company, have been forced to more than double their plant by a recent increase of business. They expect to have facilities during the coming year for manufacturing at least 500 trucks. The plant includes a large blacksmith shop and machine shop, and will have about 60 hands.

Curtis & Curtis, Bridgeport, Conn., have issued a new catalogue illustrating and describing their specialties, which, as our readers know, consist of pipe-cutting and pipe-threading machinery and fixtures. The catalogue is well illustrated and printed, and should be in the hands of every one who is interested in such machinery and tools. On the back of cover there is a table of wrought-iron pipe measurements which will prove convenient.

The Hanover Foundry and Machine Company, was recently organized at Hanover, Pa., with a capital stock of $40,000, with privilege to increase to $100,000. The size of the machine shop will be 90x100 feet, of the foundry 60x70 feet, and other buildings will be erected. The company will manufacture engines, threshers, all kinds of mill machinery, including paper-mill machinery, and will occupy the saw shops about the first of December.

Mr. William Gregory (surviving partner of the firm of James Gregory) has established a brass foundry and brass finishing shop at 214 Front street, New York City. Mr. Gregory will pay particular attention to the production of high grade and special work, up to the heaviest used in sugar establishments, yachts and ships. An improved deck pump, which has been adopted by the U. S. Navy, will be manufactured. The building is five stories high, and the foundry is at the top.

The plant of the Columbia Iron and Steel Company at Uniontown, Pa., which was recently put in operation after a long idleness, caused by the assignment of the firm, is at present being operated only half time. The reason given for not operating the plant in full is that the firm have not sufficient capital, and an endeavor will be made to increase the capital stock to $300,000. If this is done it is claimed the plant will be operated full time in all departments, as the firm report enough orders on hand to operate the plant to its full capacity.

The Berlin Iron Bridge Company, East Berlin, Conn., have published engravings showing an interior view and plan of their new plant. In this it has, of course, been the object to illustrate how a shop should be built, and no pains have been spared to have the building and arrangements generally as near perfect as possible. The building is made entirely of iron and glass, no wood entering into its construction. Those who are interested in "shopitecture," and can make it convenient to see these shops, should not fail to do so.

Messrs. J. F. Webster and A. J. Perks, two well-known mechanics, of Springfield, Ohio, who have until recently been holding positions of responsibility with Wilson, Whitely & Co., which they have resigned, are now erecting, in Springfield, a two-story shop, 40x112 feet, which they are equipping with tools for carrying on a general machine shop business. Among other things which they expect to make is an improved reducing motion for indicators, and a new bolt cutter. The new concern will be known as the Webster & Perks Tool Company.

Case of Steel Rules.

On this page we give an illustration showing a form in which J. Wyke & Co., of East Boston, Mass., are now putting up sets of their well known "Wyke's Combination Rules," from 2" to 6" long. The case is of morocco, lined with plush, and makes a very handsome as well as useful addition to a machinist's kit. Scales kept in this way are always readily found, and are not injured by contact with other tools.

A New Heavy 12-inch Standard Molder.

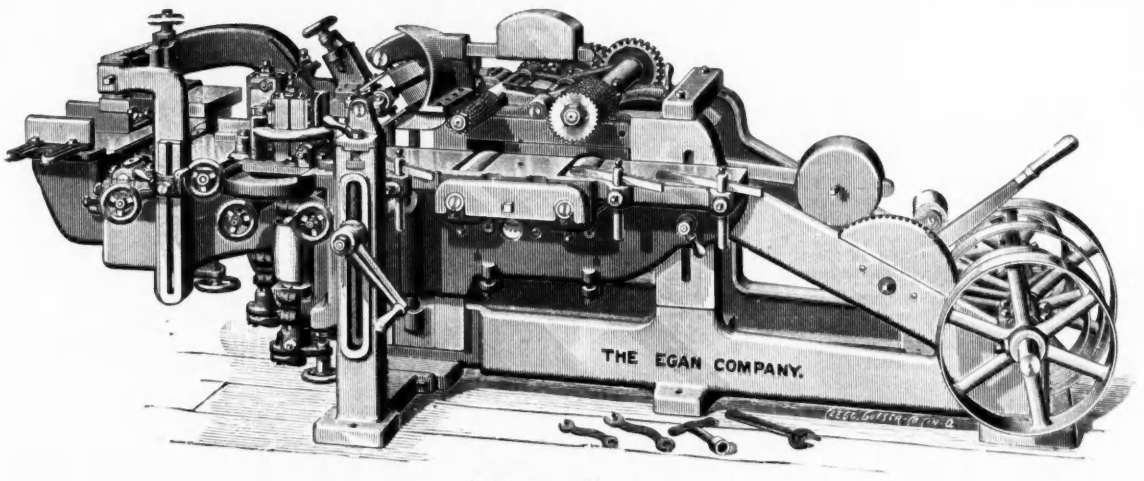
The accompanying illustration represents a heavy four-sided molder, designed for extra heavy work as well as for light work, and is well adapted for planing and dressing all kinds of heavy building material, car work, mantel work, etc. It is claimed that this machine can do heavier work than others of its class, as it has a capacity of planing timber 8x8 inches on all four sides at one operation in a very satisfactory manner. This is considered to be a great achievement, and a marked advancement in this type of machinery. It possesses other valuable features and improvements which add to the value of the machine, such as convenience of handling, and easy running. The side heads with their spindles raise and lower with the table, and both inside and outside spindles are adjustable vertically and horizontally while in operation by hand-wheels on the front side below the bed. The under head is also adjustable laterally. There are chip breakers to every head, arranged to prevent the tearing of any of them.

A patent bonnet can be adjusted to or from the head, independent of the adjustable shoe, which can be brought clear under the knife. The bonnet swivels on a stud, and can be swung clear out of the way, giving free access to the knives. The pressure foot for the lower head is a cored arm projecting from the back of the frame, and supported at the front of the bed, capable of holding the work down solid to the bed, and insuring perfect work on the lower cylinder.

The feed is very powerful, and consists of four rolls—two in the bed and two above; all are driven by suitable gearing, and the expansion for the lower rolls is so arranged that the bed can be lowered 16 inches with the feed remaining as powerful as before. There are two feeds on the machine. The upper feed spindles are hung on links in such a manner that the feed rolls raise up parallel, giving them a full bearing on the board. By an improved system of balancing, the feed rolls can be instantly raised up, allowing the operator to slip the board back.

For the class of work for which the machine has been designed the frame is necessarily made heavy, well braced, with ample floor space. It is made comparatively long, to give the belts a sufficient pulling capacity. The spindles are made of cast-steel, large in diameter, and run in long self-oiling boxes, lined with babbitt metal.

The improved patented outside bearing is braced by a solid projection from the base of the frame. No bolts nor outside boxes have to be taken off to raise and lower the bed.



STANDARD MOLDER.

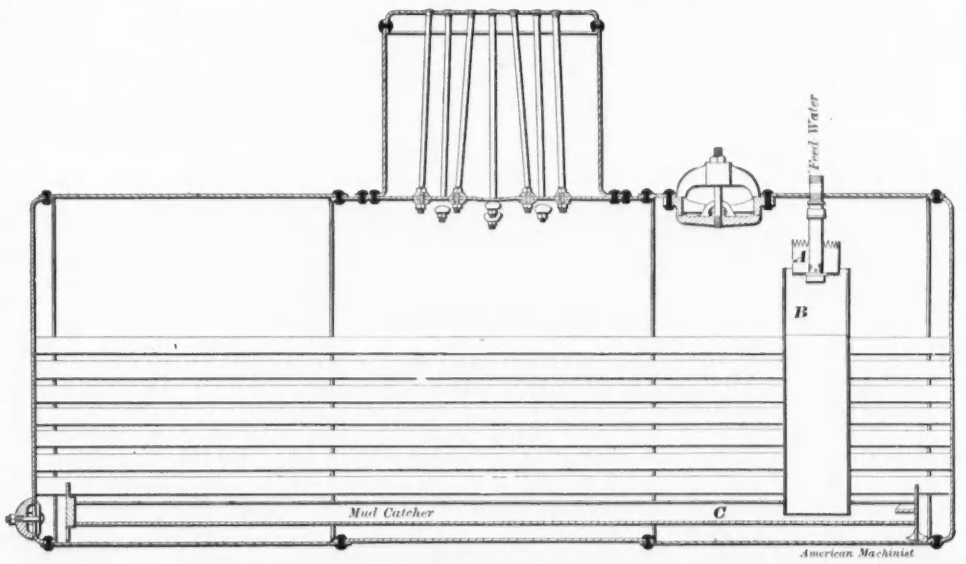
It is built by the Egan Co., Nos. 234 to 254 West Front street, Cincinnati, Ohio.

Some Points on Boiler Construction—A New Mud Catcher.

BY WILLIAM POWERS.

The principal object of this letter is to show a new mud catcher for boilers, which we have now been using long enough to convince us that, under certain pretty common conditions, it is a good thing.

From the drawings, Fig. 1 and Fig. 2, it will be seen that the boiler is fed from the top. To prevent water hammer, the feed pipe ends in a small removable cup, which holds water enough to keep the pipe filled. The cup *A* is notched around its upper and lower edges to diffuse the water as much as possible as it passes down through the steam. The receiving tank *B* is as large above the tubes as it can be, and pass through the man-hole, and has extended down from its bottom a wide thin pipe through which all feed water must pass and fill the mud catcher pipe *C* before it mingles with the water in the boiler. The mud catcher is simply made of a 6" boiler tube, flatted so as to pass through the hand-hole, slotted along the top about one inch wide, notched to receive the down pipe from tank *B*, and supported upon removable legs which keep it a couple of inches from bottom of boiler.



POINTS ON BOILER CONSTRUCTION—A MUD CATCHER.

In operation there is the advantage of keeping the cold water from striking the shell of the boiler, and the advantage, if any, of having the water pass through the steam. All oil, if any, from the engine is kept within the tank, and at least part of it sticks to the dirt and deposited lime, and to the inside of the different vessels, so that about all the mud and oil is found in the mud catcher.

While it does not catch the whole of the sulphate of lime (which sticks to whatever it first touches after it is separated from the water, and cannot be picked out by any mechanical means before), still, so far as mud and oil are concerned, the mud catcher is, with us, a success, and for the mud alone it needs no argument to convince one that the catcher is a much better place to have it than the bottom of the boiler.

In regard to staying the top of domes: Is not the plan shown correct? Putting a dome on a boiler weakens the shell, even when the shell is not cut out, because the steam pressure is equal on both sides of the shell at that point. If the shell was to be forged down, so as to run across from side to side in a straight line, then there would be no weakening, but such a procedure has never been followed, and would be expensive. Realizing that the weakness of the shell comes from the fact that there is no radial pressure on it where the dome covers, it seems that this staying the dome to that part of the shell will restore the very outward strain necessary to make that part of the boiler equal to the other. By this method of staying there is greatly less strain to tear the dome from the shell than when the stays fasten to the dome, as is customary. As there is no call for a steam joint where stays are fastened to shell of boiler, various methods of construction are open to the builder.

The comparatively small hole from the shell to the dome is common in this locality, and while it may not be the best practice, no bad effects, so far as lifting water is concerned, seem to come from it.

A common method of supporting such boilers is shown at *D*, Fig. 2. It serves the purpose, and no bad effects seem to come from it, but scientifically considered it would be hard to devise a worse plan.

The method shown at *E*, when the boiler is suspended, is nearer correct. When a thing has answered the purpose, it is easier and cheaper, and calls for much less talking to keep on using than when a change is made; but boilers have unavoidable strain enough to stand, without adding the buckling strain such as must arise from the use of such brackets as shown at *D*.

The question of the dome stays ought certainly to be discussed; no one will dispute that the ordinary dome weakens the shell, or question but what this method of staying will lessen the danger of leakages around the base of the dome. To understand why it should strengthen the shell is not so easy to comprehend, but a careful calculation the writer believes will demonstrate that it will so act.

The writer does not wish to be understood as advocating the use of a dome at all, believing that the metal can be put to a better use. Take, for example, the boiler shown, which is one made by reputable builders and in extended use, 5'x13' with a 3'x2'8" dome. In this case the dome will take at least 42 square feet of boiler plate, which would be ample to increase the heads and shell to a boiler 5'8" in diameter. Such a shell without a dome would be about as strong as a five-foot boiler with dome as usually attached, and this five-foot-eight-inch boiler with the same number of tubes, the same distance apart, would have its tube line about level with the center of boiler, whereas the one shown has its tube line six inches above center.

This will give ten square feet more separating surface at the water level, 14" more distance between the top of water and top of boiler, and give over 50 cubic feet of steam room more than in the five-foot boiler.

It is usual to use the dry pipe in the domeless boiler, and perforate it either on top or all around. That is just the wrong thing to do. The holes should be on the bottom, and the area of the holes should not exceed the area of the dry pipe more than 50 per cent.; at least this is true with certain water.

In the Dominion of Canada there were up to June 30, 1890, 14,004.13 miles of railroad under operation. Total number of passengers carried, 12,821,262; total number of tons of freight of 2,000 pounds handled, 20,787,469. Gross earnings, passenger traffic, $13,731,769; freight traffic, $29,921,788.

Machinists' Supplies and Iron.

NEW YORK, September 19, 1891.

Iron—American Pig—The market shows more steadiness, but without any advance.

We quote: Standard Northern brands, No. 1 Foundry, $16.75 to $18; No. 2 is selling at $15.50 to $16.50, and Gray Forge at $13.90 to $15. Southern brands of good quality are obtainable at $16 to $17.50 for No. 1 Foundry; $15.75 to $16 for No. 2; and $14 to $14.50 for No. 3.

Scotch Pig—We quote Coltness at $23, and Eglington, $20.50.

Copper—Lake Copper is about steady, with 12.15c. bid, and 12⅜c. to 12½c. asked, but no business. Casting Copper is steady at 11¼c. to 11½c. Arizona Ingot is in moderate demand at 12c. to 12½c.

Lead—Pig Lead has a better inquiry, and considerable more business has been done in a small way, but the feeling is not considered so firm. There are buyers at 4.40c., and sellers at 4.50c. to 4.55c. Buyers lack confidence, and are postponing wants.

Spelter—No stock can be bought for less than 4.90c., and no sales can be made at 4.95c. The actual market value is between that range. There is no demand to speak of.

Tin—Lower prices are quoted on account of the continued easy London market. For spot, 19.92½c. is bid, and 20.05c. asked.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—Place in a machine shop to go under instructions. Address Industrious, AM. MACHINIST.

Wanted—Competent draftsman on printing machinery. Address Cylinder, Box 58, AM. MACHINIST.

Wanted—A first-class machinist with executive ability, as foreman of a machine shop building gas engines. Address Box 59, AMERICAN MACHINIST.

1st-class mech. draftsman, with exp. in steam and steam power plants, power transmitting and pumping mach'y, wishes situation. X., AM. MACH.

Young man (21) 5 years' experience pattern making and draftsman, wishes position with mech. engineer as assistant. Box 63, AMERICAN MACHINIST.

Tool maker, well up in modern shop tools and methods, would like situation. First-class references. Address Box 66, AMERICAN MACHINIST.

Wanted—Foundry foreman under forty, capable of taking charge of shop making specialty of small soft iron castings. Address M. & L., AM. MACH.

Two 1st-class draftsmen, experienced on steam work and general machinery, desire to change their positions. Address Box 68, AMERICAN MACHINIST.

Wanted—Position as foundry foreman; thoroughly understands his business in all its branches. Address J. A., Box 175, North Andover, Mass

A position wanted as foreman boiler maker, or laying out work in a marine shop, by a practical man of long experience and thorough capability. Address Boiler Maker, AMERICAN MACHINIST.

Wanted—Position as foreman boiler maker by a man of large experience with locomotive, stationary and all kinds of sheet-iron work; best of refs.; 10 years as foreman. Address Box 61, AM. MACH.

Mechanical draftsman, 25, college graduate, with 4 years prac. exp. in high-speed engines and boilers (stat. and port.) wants to make a change. Terms moderate. Address Box 65, AMERICAN MACHINIST.

Wanted—A first-class foundry foreman on printing press and general work. A young man preferred. Address, giving age, past and present employers, W. H. M., Box 235, Boston, Mass.

Wanted—A first-class mechanic, conversant with the construction, repairing and operation of locomotives in all details; applicants must be temperate, giving refs., and salary expected. Wm. Douglas, Gen'l Supt. M. & N. E. R. R., Manistee, Mich.

Mechanical engineer desires a position; have 18 years' experience as machinist, pattern maker, draftsman and marine engineer (British certificates). 8 years last situation as chief draftsman & master mech. 1st-class refs. M. H. E., AM. MACH.

Position wanted by first-class mechanical draftsman, with good experience in steam and marine engine, ice and mining machinery, sugar refineries, steel works, designing of factories, and general engineering. H. S., AMERICAN MACHINIST.

A superintendent, at present in charge of machine screw works, desires similar position in turret machine department, where rapid and accurate work is required, or in shop building screw machines. Address X. Y., AMERICAN MACHINIST.

Mech. engineer with 12 yrs. practical experience, who has successfully filled important positions in large mfg. concerns, is open for engagement. Experienced in modern methods of manufacture, and in the handling of men. Box 60, AM. MACHINIST.

Wanted—By advertiser, who is a thorough machinist, also has been engaged for past 8 years as salesman in the mach'y and supply business, a situation either as salesman where mech. ability is required, or would take charge of machinery in a large factory, or would go as assistant; best references. Apply to Box 64, AMERICAN MACHINIST.

An energetic young man, who is a thorough mechanic, and has had extensive experience in shop management, also good draftsman and designer of tools and appliances for getting out work economically and in good shape, wants to correspond with parties needing such a man. 1st-class medium or light work preferred. Box 67, AM. MACHINIST.

Wanted—A position by a young machinist of 25, in a machine shop, or as engineer in a plant where some one is wanted who is able to make repairs and look after running machinery; can give references from last employer. Address, stating wages, and work expected; am sober, steady and industrious, and would like steady employment. G. A. Keplogle, 36 Albemarle street, Indianapolis, Indiana.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Wanted—Specialties to build for the Southern trade. Bluefield Iron Works, Bluefield, W. Va.

Wanted—Novelties to build. McNair Tool Company, Meadville, Pa.

Working drawings of machinery and plans of mills drawn. Address Box 40, AMERICAN MACHINIST.

Agents wanted in every shop, for Surface Gauges as illus. in A. M. Sept. 10. E. G. Smith, Columbia, Pa.

Wanted—Partner with $1,500 capital, in an established machine business. Box 62, AM. MACHINIST.

Corliss engs. and gen. mach'y designed, working drawings made. A. W. Jacobi, 136 Liberty St., N. Y.

Special leather and cement for covering pulleys; no rivets required; local agents wanted. Crescent Mfg. Company, Cleveland, Ohio.

For Sale Cheap or Exchange—Eleven right and left modern Patent Automatic Cut-off Engine Patterns & Drawings, from 10" to 20". B 9, AM. MACH

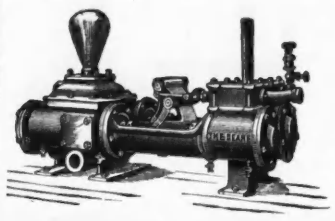
For Sale—Three 3-ton jib cranes, 20 feet height of mast, swing in space of 35 feet. Apply to The J. Morton Poole Company, Wilmington, Delaware

For Sale—A small machine shop building a patent tool meeting with ready sale. Price together, $4,000, or will be sold separately. Address W. S., AMERICAN MACHINIST.

For Sale—Lot of partially completed two horse-power engines, boilers, tubing, etc. American B H. O. & Sewing Machine Co., S. W. Cor. 20th and Washington Avenue, Philadelphia, Pa.

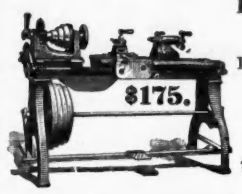
Wanted—An eastern agency to be locatad at Boston, for some manufacturing company or foundry, by a mechanical engineer of large business acquaintance. Engineer, Box 3491, Boston, Mass.

Wanted—Engineers to write for catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent. Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.



THE DEANE
OF HOLYOKE
STEAM PUMPS
DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

CRESCENT STEEL CO.
Pittsburgh, Pa.
Chicago, Ills.
New York, N. Y.
TOOL & DIE STEEL
of Uniform Quality and Great Strength.

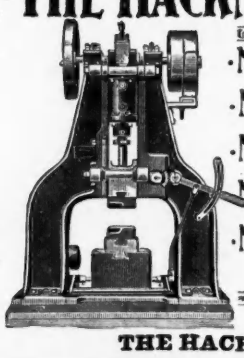


Improved Screw Cutting Foot and Power. LATHES
Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
THE SEBASTIAN-MAY CO.,
167 to 175 Highland Avenue, SIDNEY, OHIO.
MONTGOMERY & CO., 105 Fulton St., New York, Gen'l Agents.

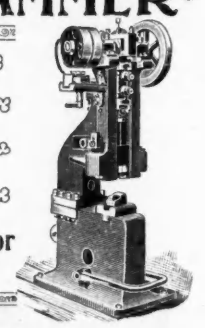
FINE TAPS, DIES, REAMERS, ETC.,
LIGHTNING AND GREEN RIVER SCREW PLATES.

Bolt Cutters, Hand and Power Drilling Machines, Punching Presses, Tire Benders, Tire Upsetters and Other Labor-saving Tools. Send for Price List.
WILEY & RUSSELL MFG. CO., Greenfield, Mass. New York Agency, 126 Liberty St.

THE HACKNEY POWER HAMMER



No Rubber Cushions to wear out.
No Straps to Break.
No Springs to crystallize.
No adjustments to be made.
No alteration in speed for light or Heavy blow.



THE HACKNEY HAMMER CO., CLEVELAND, O.

JESSOP'S STEEL
For TOOLS, DRILLS, DIES, &C.
All Kinds in Stock.
Gold Medal, Paris, 1889.
MANUFACTORY,
WILLIAM JESSOP & SONS, LD. | SHEFFIELD, ENGLAND. | Chief American Office, 91 JOHN ST., NEW YORK.

R. MUSHET'S SPECIAL and TITANIC STEELS.
How to get the best results with "R. MUSHET'S SPECIAL STEEL." Greatly increase your speeds and feeds; then compare the work you turn off with that done by any other known Steel This will make the first cost of "Mushet's" look insignificant.
B. M. JONES & CO.,
Sole Representatives in the United States.
11 & 13 Oliver St., BOSTON, MASS.
143 Liberty St., NEW YORK.

FOR SALE
SECOND-HAND MACHINERY.
Planer, planes 54 inch wide, 24½ feet long, Betts Machine Co.
Planer, planes 72 inch wide, 12½ ft. long, L. W. Pond Mach. Co
The above tools can be seen running.
Planer, planes 30 inch wide, 8 ft. long, D. W. Pond.
Planer, planes 30 inch wide, 5 ft. long, Cove Machine Co.
Engine Lathe, 54 inch swing, 21 ft. bed, Putnam Machine Co.
Engine Lathe, 24 inch swing, 20 ft. bed, with three tool shafting rests, D. W. Pond.
Engine Lathe, 16 inch swing 8 ft. bed with taper attachment, Wheeler.
Upright Drill, 30 inch swing, Putnam Machine Co.
8 inch × 6 ft. Engine Lathe.
Sellers Bolt Cutter 1 1 2 inch.
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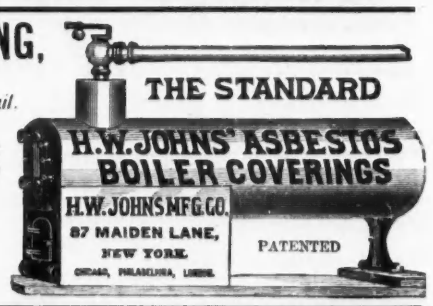

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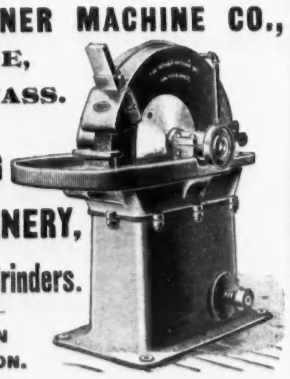

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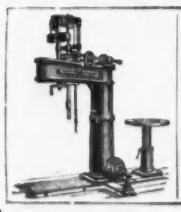

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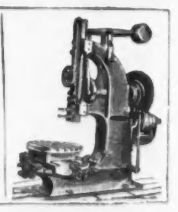

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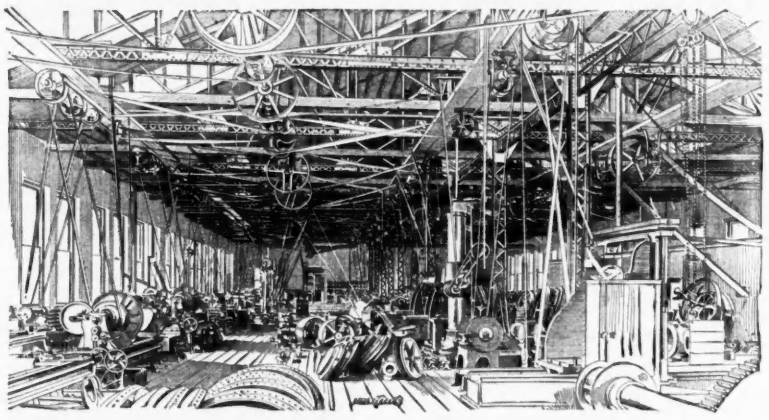

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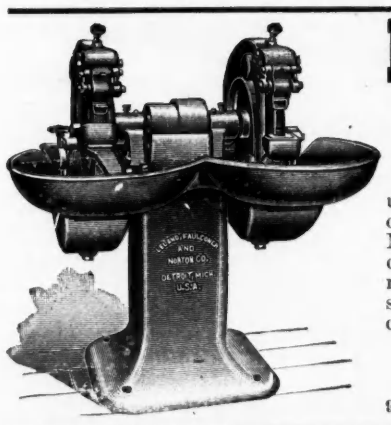

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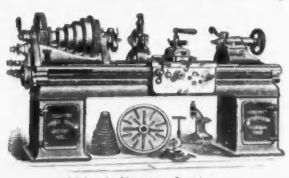

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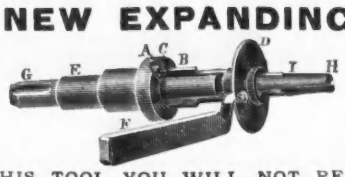

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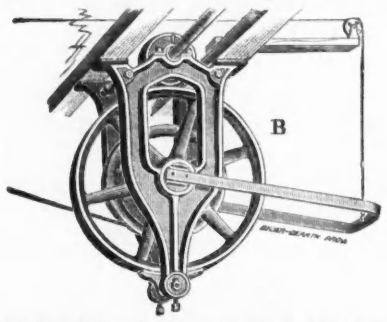

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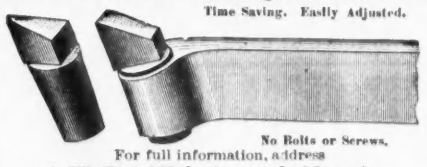

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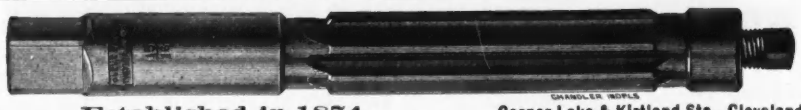

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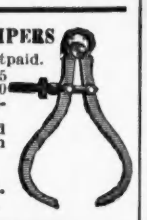

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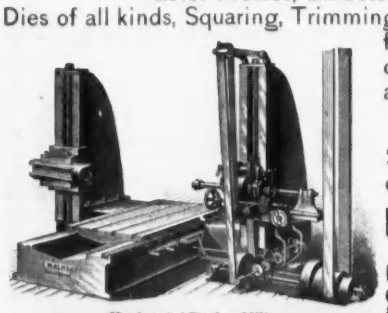

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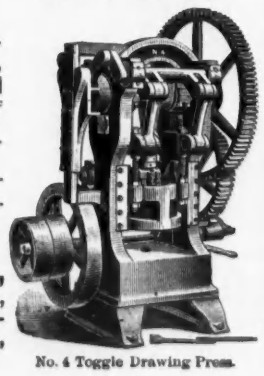

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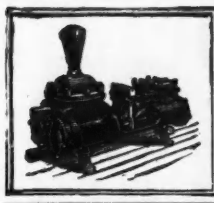

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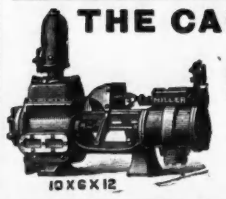

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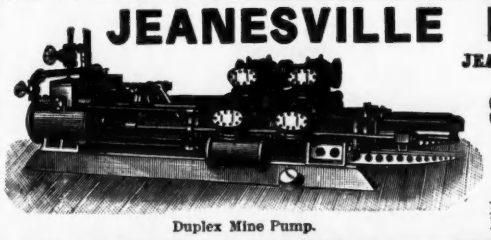

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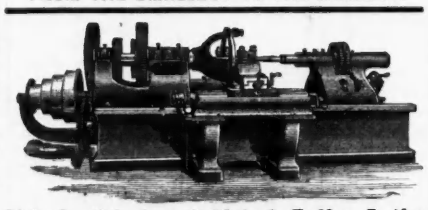

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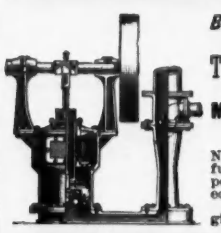

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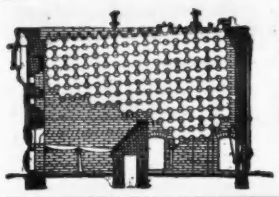

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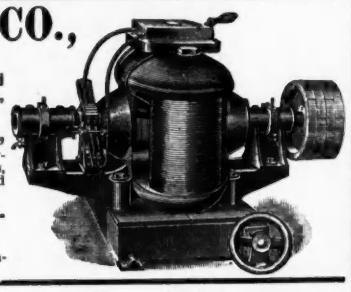

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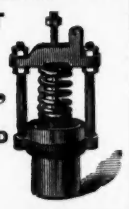

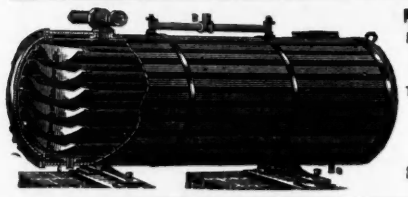

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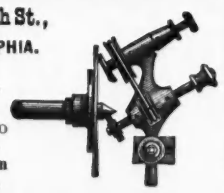

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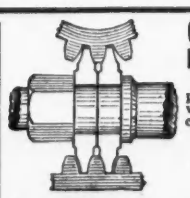

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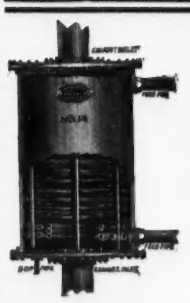

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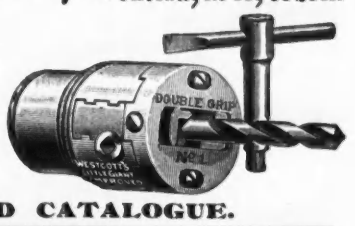

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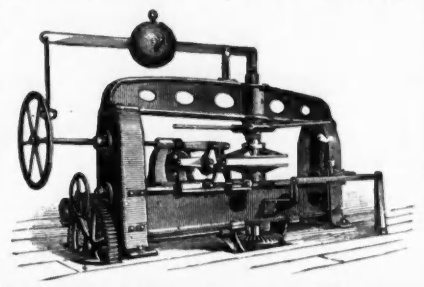

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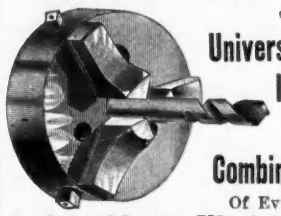

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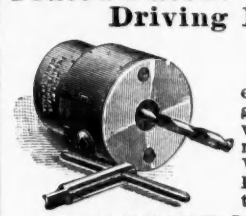

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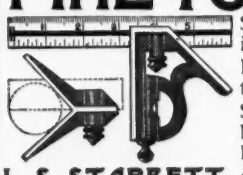

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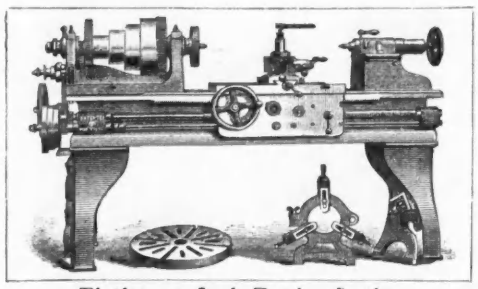

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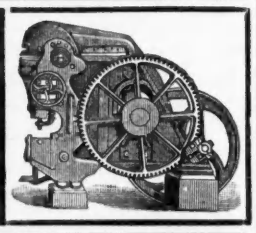

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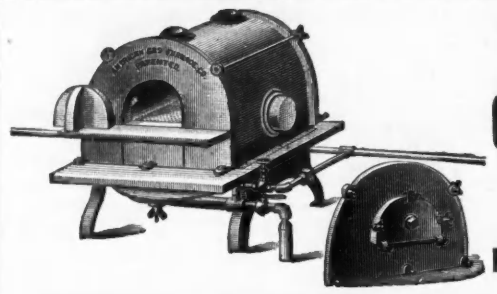

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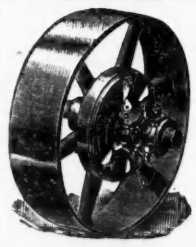

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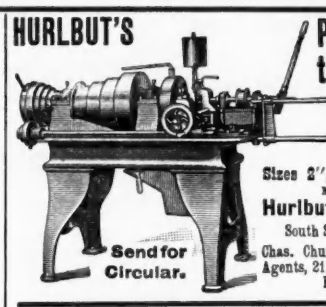

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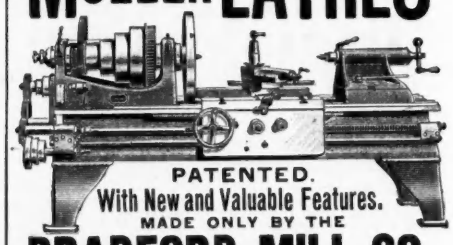

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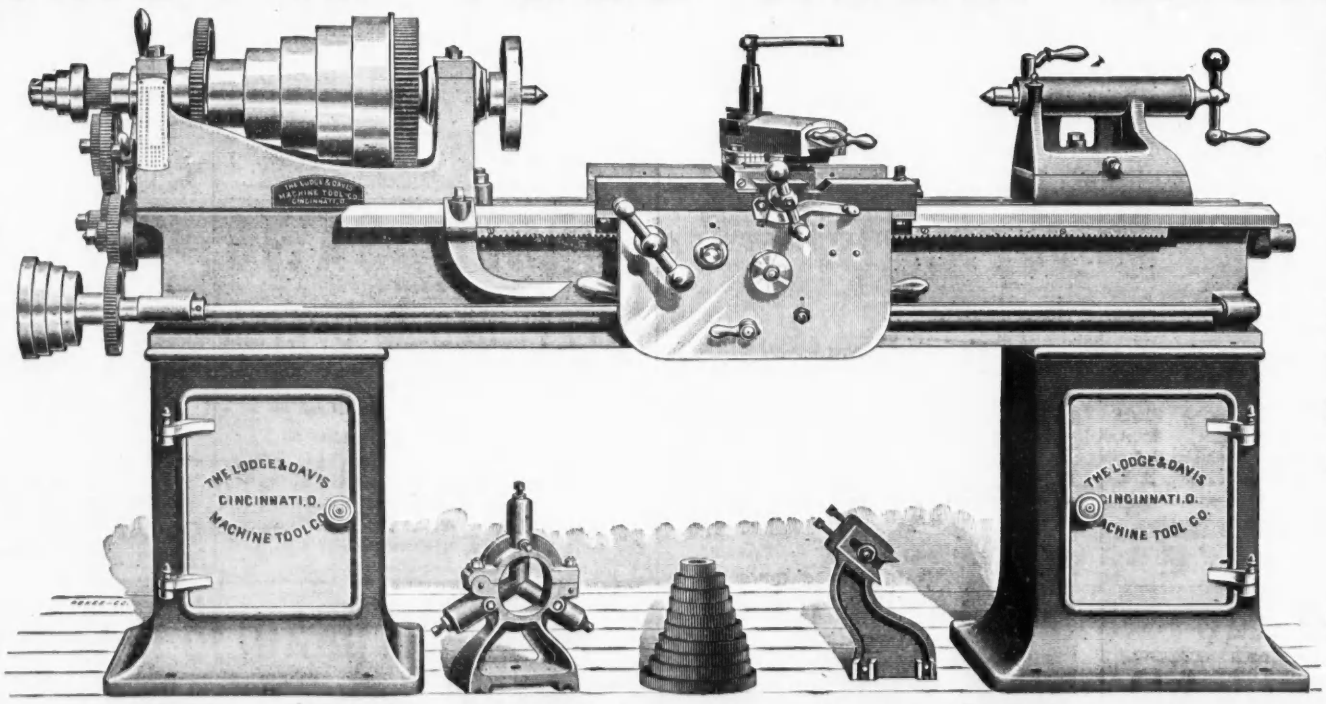

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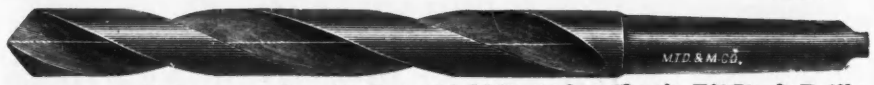

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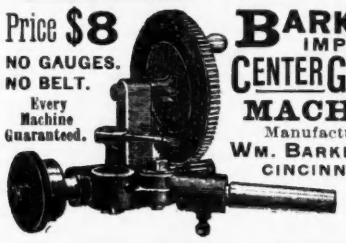

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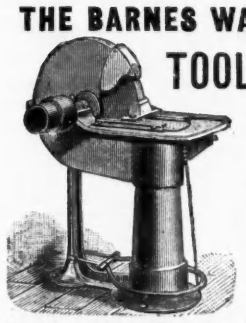

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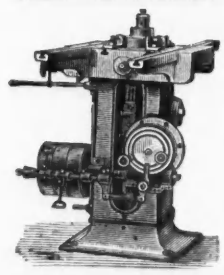

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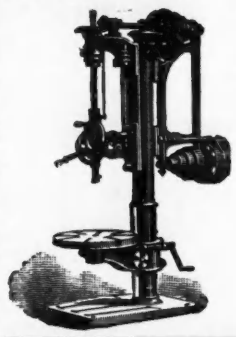

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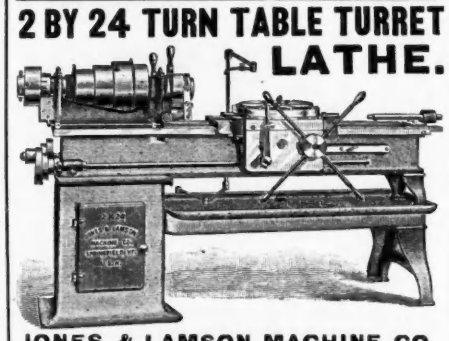

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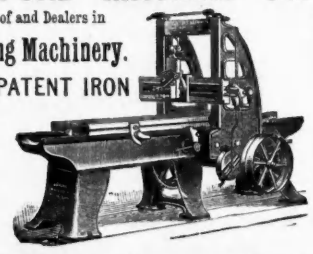

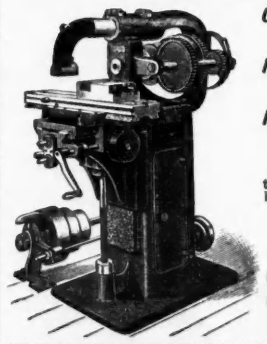

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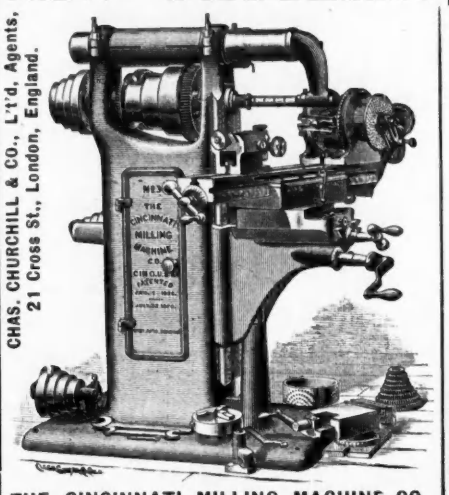

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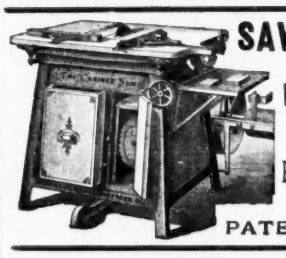

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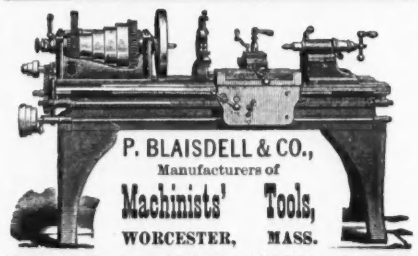

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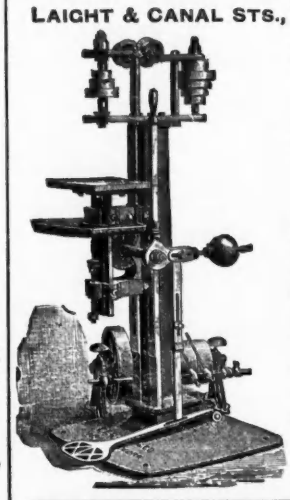

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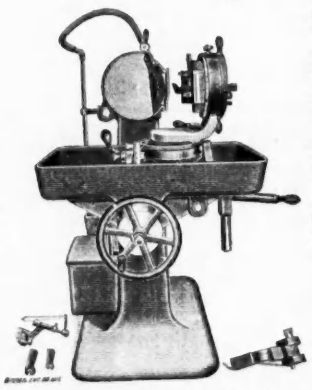

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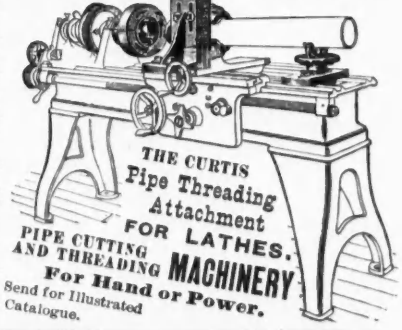

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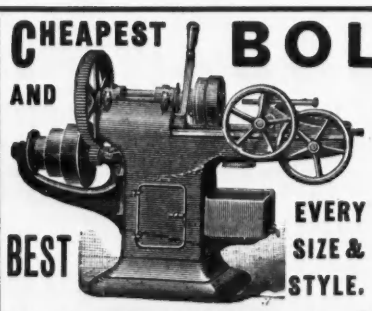

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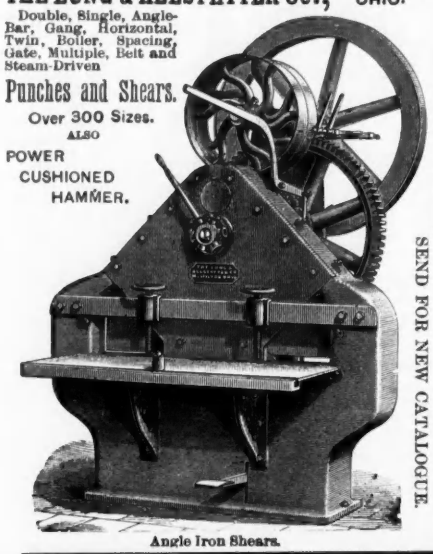

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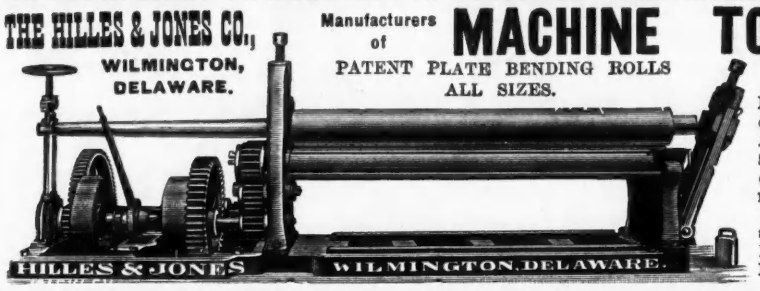

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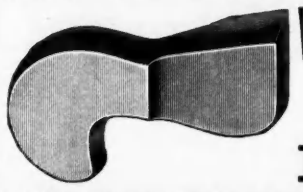

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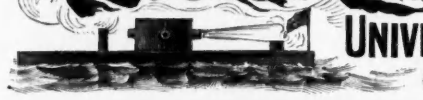

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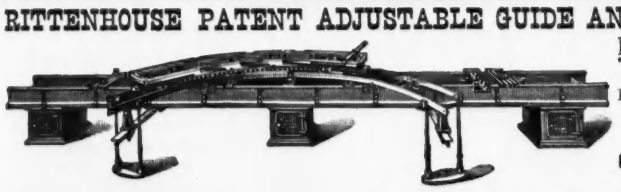

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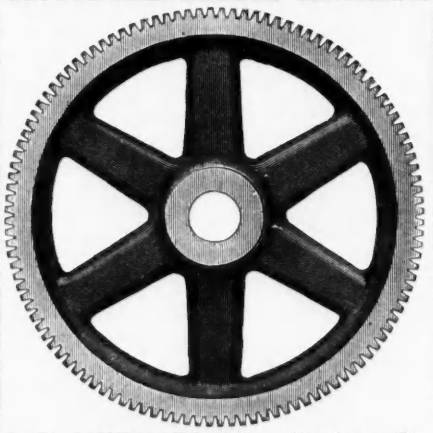

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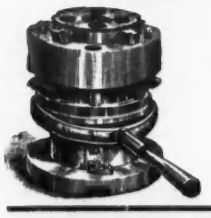

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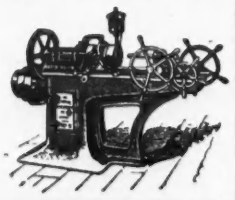

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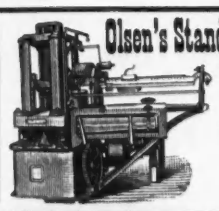

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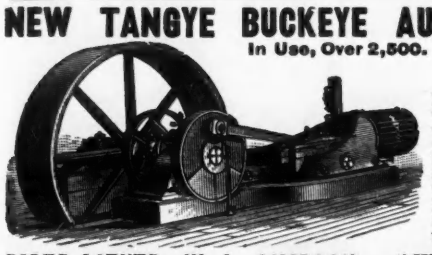

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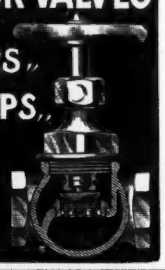

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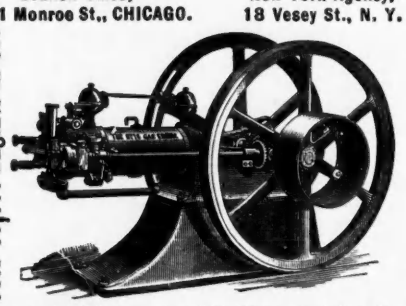

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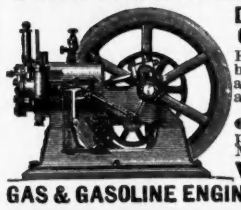

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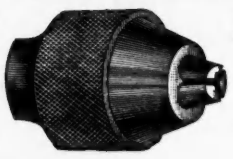

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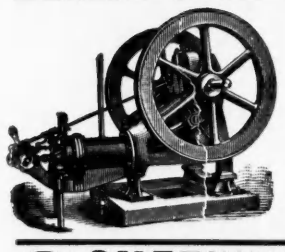

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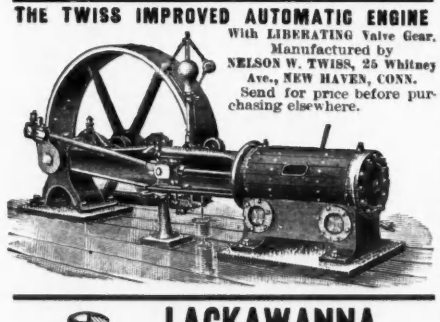

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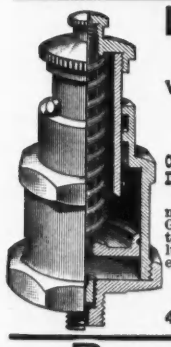

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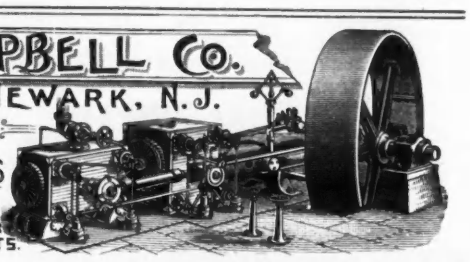

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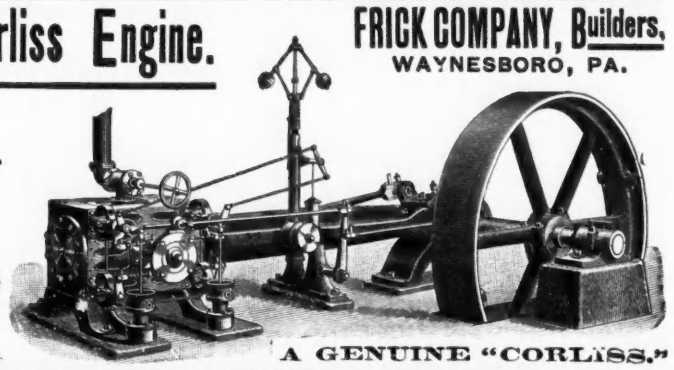

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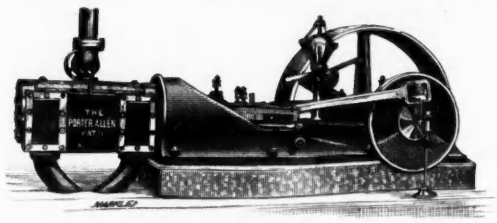

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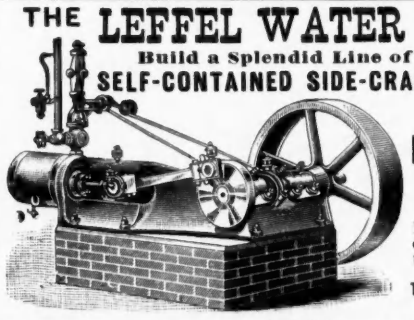

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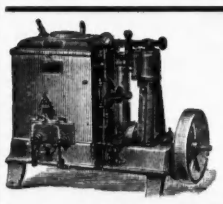

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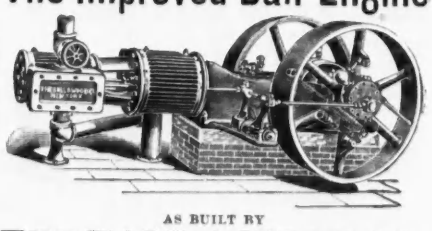

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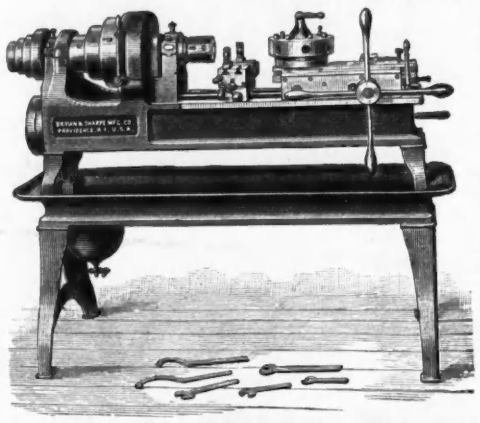

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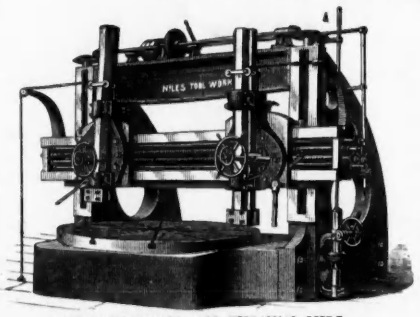

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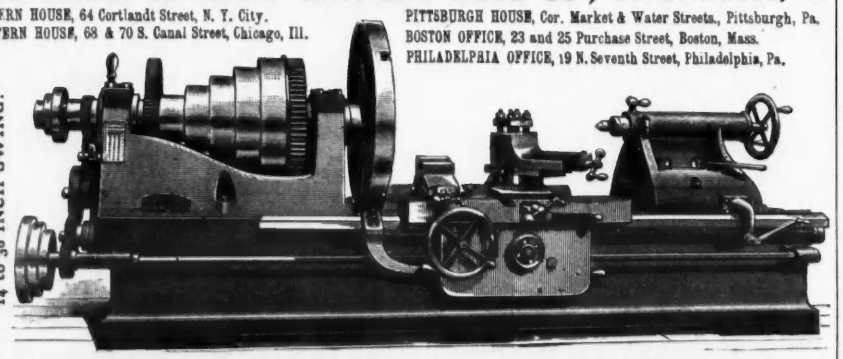

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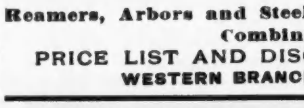

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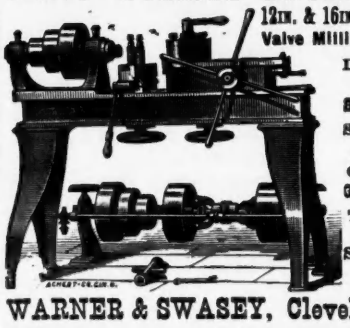

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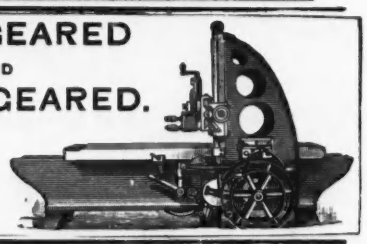

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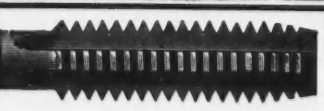

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